



NASA SP-7036(01)

Section 1

Abstracts

REMOTE SENSING OF EARTH RESOURCES

(1970 - 1973 SUPPLEMENT)

A LITERATURE SURVEY WITH INDEXES

Section 1 • Abstracts

FEBRUARY 1975

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REMOTE SENSING OF EARTH RESOURCES

A Literature Survey

With Indexes

(1970 - 1973 SUPPLEMENT)

Section 1 • Abstracts

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced between March 1970 and December 1973 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA)*



Scientific and Technical Information Office

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INTRODUCTION

This literature survey cites 4930 reports, articles and other documents that were announced between March 1970 and December 1973 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*. This publication supplements *Remote Sensing of Earth Resources* (NASA-SP-7036) that cited documents announced between January 1962 and February 1970. Beginning in 1974, a quarterly publication, *Earth Resources, A Continuing Bibliography* (NASA-SP-7041) was initiated. The first issue, NASA-SP-7041(01), was published in June 1974 covering the documents announced between January 1974 and March 1974.

The coverage includes documents related to the identification and evaluation by means of sensors in spacecraft and aircraft of vegetation, minerals, and other natural resources, and the techniques and potentialities of surveying and keeping up-to-date inventories of such riches. It encompasses studies of such natural phenomena as earthquakes, volcanoes, ocean currents and magnetic fields; and such cultural phenomena as cities, transportation networks, and irrigation systems. Descriptions of the components and use of remote sensing and geophysical instrumentation, their subsystems, observational procedures, signature and analyses and interpretive techniques for gathering data are also included. Reports generated under NASA's Earth Resources Survey Program and announced during the period covered by this bibliography are included.

Because of the volume of citations, the *Abstract Section (Section 1)* and the *Index Section (Section 2)* are separately bound.

Abstract Section (Section 1). The *Abstract Section* is divided into nine subject categories (see Table of Contents for scope note of each category). Each entry consists of a standard bibliographic citation accompanied, in most cases, by an abstract. Each of the citations has several data elements useful for identification and indexing purposes. Typical citations from *STAR* and *IAA* appear on page viii following the Table of Contents. The citations and abstracts are reproduced exactly as they appeared originally in *STAR*, or *IAA*, including the original accession numbers from the respective announcement journals. This procedure, which saves time and money, accounts for the variation in citation appearance.

Under each of the nine categories, the entries are presented in one of two groups that appear in the following order:

- *IAA* entries identified by accession number series A70-10,000 in ascending accession number order.
- *STAR* entries identified by accession number series N70-10,000 in ascending accession number order.

Index Section (Section 2). The *Index Section* is divided into the following five indexes -- subject, personal author, corporate source, contract number and report/accession number. Typical index listings appear at the beginning of each index. The subject indexing that originally appeared in *STAR* or *IAA* has been augmented by the addition of geographical place names to improve the retrieval of such places in this publication.

AVAILABILITY OF CITED PUBLICATIONS

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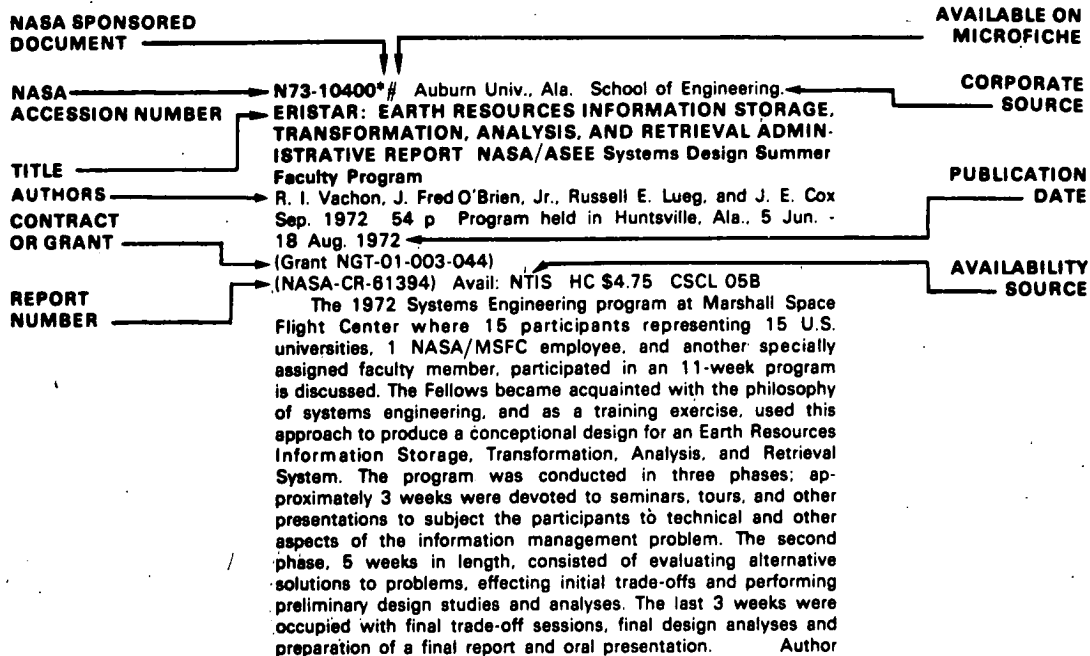
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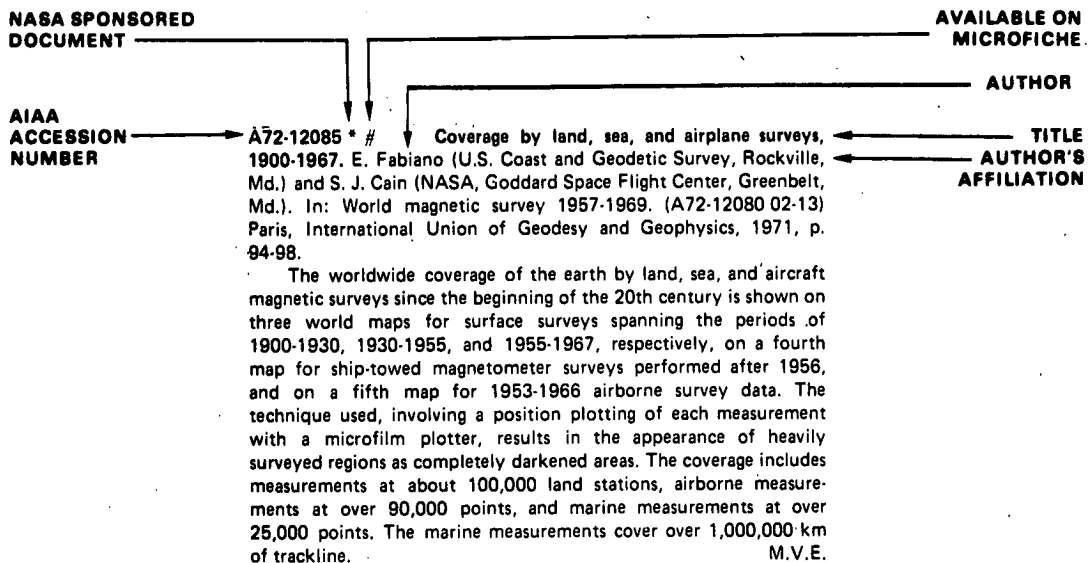
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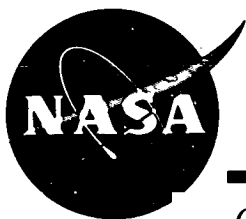
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TYPICAL CITATION AND ABSTRACT FROM IAA





REMOTE SENSING OF EARTH RESOURCES

a literature survey

FEBRUARY 1975

01

AGRICULTURE AND FORESTRY

Includes crop forecasts, crop signature analysis, soil identification, disease detection, harvest estimates, range resources, timber inventory, forest fire detection, and wildlife migration patterns.

A70-16144

IR COLOR FOR CROP DISEASE IDENTIFICATION.

L. E. Philpotts and V. R. Wallen (Department of Agriculture, Ottawa, Canada).

Photogrammetric Engineering, vol. 35, Nov. 1969, p. 1116-1123, 1125. 12 refs.

Use of aerial color IR photography to identify bacterial blights and root rot in field beans by tonal and geographic patterns. The importance of using blight-free bean seed is clearly demonstrated by this technique. The cameras, films, filters, and exposure procedures are described.

Z.W.

A70-16164 * #

REMOTE SENSING OF AGRICULTURE FORESTRY AND WATER RESOURCES.

Ronald J. Schertler (NASA, Lewis Research Center, Cleveland, Ohio).

American Society of Farm Managers and Rural Appraisers, Conference, Chicago, Ill., Dec. 2, 1969, Paper. 22 p.

Review of some applications of remote-sensing aerial and space surveys to agriculture, forestry, and water resources. Current NASA programs focus primarily on the development of various remote-sensing imaging systems along with information acquisition and analysis techniques. Extensive aircraft surveys of selected "ground truth" test sites have helped to document the spectral response of various resource phenomena. Some of the results in the areas of land use, crop and timberland surveys, assessment of plant health and deterioration, and hydrological information on sediment and salt deposits are reviewed.

M.V.E.

A70-22263

Time dimension for crop surveys from space.

Dieter Steiner (Waterloo, University, Waterloo, Ontario, Canada). (American Society of Photogrammetry, Annual Meeting, 35th, Washington, D.C., March 9-14, 1969, Technical Papers, p. 286-300.) *Photogrammetric Engineering*, vol. 36, Feb. 1970, p. 187-194. 20 refs.

Summary of experiments in automated crop surveys, based on an integration of observations made at a number of different times during the growing season. The use of the time dimension to replace spectral dimensioning is closely linked to the likelihood that operational earth resources satellites will be in orbit in the future, pro-

viding a surveying platform continuously circling the earth. An example of the application of discriminant analysis to time sequence data is given. A comparison of computer-generated group frequencies with actual group frequencies is presented for a number of crops.

B.H.

A70-22855 #

A system analysis of applications of earth orbital space technology to selected cases in water management and agriculture. A. H. Muir (Earth Satellite Corp., Washington, D.C.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-335. 11 p. 5 refs. Members, \$1.00; nonmembers, \$1.50.*

This paper reports on a multi-discipline systems study undertaken for NASA to conceptualize a satellite-assisted information system to improve earth resource management in the areas of regional water management, wheat crop management and wheat rust control. Since in a short paper it is not practical to deal with each of the three cases equally, examples will be chosen from the water management case to illustrate a number of relevant points. Dependency matrices will be shown for all three cases in order to show the general applicability of the method employed. In order to conceptualize a realistic satellite-assisted information system, it was necessary to develop 'User Decision Models'. This approach was based on the conviction that any systems analysis must begin with an understanding of exactly how earth sensing information might both be utilized and managed within an existing or recommended operating system. The objective of the case studies was to develop a detailed total system concept utilizing satellites to assist in special areas of resource management. A practical system concept emerged from the case studies and particular attention was focused on a technique of dynamic sampling which appears to make the system much more feasible given the current state-of-the-art. (Author)

A70-22868 #

Remote sensors—A new data source for agricultural statistics. Earl E. Houseman (U.S. Department of Agriculture, Washington, D.C.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-312. 4 p. Members, \$1.00; nonmembers, \$1.50.*

Study of the processing of remote sensing recordings and the channels of information flow which, with reference to agricultural statistics, must be in agreement with appropriate statistical standards, and with the practical uses which develop. To the extent that remote sensing develops into a useful source of statistics, its major role is considered to be an additional important source of data that should feed into the existing statistical system in order to be utilized for the improvement of accuracy and scope of some kinds of agricultural statistics. The reasoning underlying this view is briefly outlined, and includes the coordinating and reconciling of data from various sources as a necessary part of the process of preparing forecasts and estimates. The same statistical policy involving matters of confidentiality and standards should, it is considered, apply to all sources of data and the release of estimates.

F.R.J

01 AGRICULTURE AND FORESTRY

A70-22879 # Machine-aided photo interpretation techniques for vegetation analysis. J. D. Lent and J. D. Nichols (California, University, Berkeley, Calif.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-308.* 9 p. Members, \$1.00; nonmembers, \$1.50.

Exploration of some of the capabilities which various remote systems offer, in terms of spatial resolution and user requirements, for obtaining rapid land-use inventories. This is accomplished by a discussion of machine-aided analytical techniques for data reduction and analysis. The discussion is compared with its counterpart in conventional photo interpretation techniques and results. With respect to vegetation-oriented resource inventories in the U.S., the land-use manager is mainly concerned with the categories of agriculture, forests, rangelands, and brushlands. It is considered that scanning microdensitometry and appropriate software analysis can be of great assistance to the human interpreter's overall task. F.R.L.

A70-23753 Airborne infrared line scanners for forest fire surveillance. Stanley N. Hirsch and Forrest H. Madden (U.S. Department of Agriculture, Forest Service, Missoula, Mont.). In: *Photo-optical instrumentation applications and theory; Society of Photo-optical Instrumentation Engineers, Annual Technical Symposium and Exhibit, 14th, San Francisco, Calif., August 11-14, 1969, Proceedings, Volume 2.* Symposium co-sponsored by the U.S. Army and the U.S. Air Force. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1969, p. 51-57. 5 refs.

Airborne infrared line-scanning systems for detecting latent forest fires and for determining the size and characteristics of conflagrations when smoke or darkness prevents obtaining this information visually have been developed and tested. A prototype system is operational in the U.S.D.A. Forest Service fire suppression organization; its usefulness in helping suppress large fires is well established. During 1967, a fire detection system was flight-tested; more than 600 targets were detected and their positions plotted. A unique target discrimination module for automatically identifying hot targets was developed and evaluated. In 1968 system performance was improved by including a second detector to permit identification of hot targets by real-time analysis of spectral signatures. This system is now undergoing tests of operational suitability in an 8,000-square-mile area in western Montana. The equipment design, performance characteristics, and operational methodology are discussed, along with future display and recording requirements. (Author)

A70-24734 ADP of aerial imagery for forest discrimination. Leonard A. LeSchack (Development and Resources Transportation Co., Silver Spring, Md.). In: *American Society of Photogrammetry, Annual Meeting, 36th, Washington, D.C., March 1-6, 1970, Technical Papers.* Falls Church, Va., American Society of Photogrammetry, 1970, p. 187-218. 6 refs. USAF-supported research; Grant No. DA-CA-39-69-C-0046; Contract No. N 00014-68-C-0102.

Preliminary work demonstrates the feasibility of utilizing power spectrum analysis as a tool for automatic processing of airborne remote sensing data for forest identification through pattern discrimination. Microdensitometers with blue, green and red filters were used to scan Ektachrome Infrared aerial transparencies of four different tropical forests and one New England evergreen forest to generate scan lines which were analyzed by power spectrum techniques. Spatial distribution information of the reflecting trees was extracted and serves to delineate unambiguously the five forests from each other. The technique described appears amenable to near real time processing with analog computers. (Author)

A70-24745 Comparison of multibase and multiemulsion photography for identifying crop and soil conditions from space. C. L. Wiegand, R. W. Leamer, D. A. Weber, and A. H. Gerbermann (U.S. Department of Agriculture, Agricultural Research Service, Weslaco, Tex.). In: *American Society of Photogrammetry, Annual Meeting, 36th, Washington, D.C., March 1-6, 1970, Technical Papers.* Falls Church, Va., American Society of Photogrammetry, 1970, p. 496-511. 7 refs.

Kodak Ektachrome Infrared Aero film SO 180 (multiemulsion) was compared with Panatomic-X exposed to green and red light, and black-and-white infrared films to discriminate crop species and soil conditions of 53 Imperial Valley, Calif., fields. Simultaneous imagery was obtained by the cluster of 4 Hasselblad cameras used in the Apollo 9 SO-65 experiment. Ground truth was used to establish the categories and to judge the accuracy of category classification. Film optical densities for the Ektachrome Infrared (IR) film were determined with no filter (white light) and with red, green, and blue filters in the light beam. For the black and white films, the optical densities were determined only to white light. The standard signature for each category was taken as the mean optical density of all fields in the category. The data were processed by a computer program that compared the signature of each field with all standard signatures. Each field was assigned to the category of the standard signature from which it deviated the least. On the Ektachrome IR image 68% of the fields were correctly identified, whereas 72% were correctly identified on the combined data from the three black-and-white images. These results suggest that multibase and multiemulsion imagery are about equally useful for crop and soil condition discrimination using optical density differences. (Author)

A70-24746 Aerial photograph use in timber management programs in the South. Robert D. Baker (Stephen F. Austin State University, Nacogdoches, Tex.). In: *American Society of Photogrammetry, Annual Meeting, 36th, Washington, D.C., March 1-6, 1970, Technical Papers.* Falls Church, Va., American Society of Photogrammetry, 1970, p. 512-520.

Survey of 31 million acres of timberland owned by forest industries and 10 million acres of national forest land in the South. The survey reveals that a high percentage of managers of these lands use aerial photographs extensively in timber stand mapping, in volume determination, and in planning and executing numerous timber management jobs. Aerial photographs are principally from government sources and from contract flying. Panchromatic photographs are used most, although modified IR photographs are also used extensively. Government photographs are not as suitable for timber management programs as contract photographs, but many respondents consider the latter too costly. M.M.

A70-24747 Evaluation of SLR imagery for interpretation of tropical lowland vegetation. Gordon E. Howard and Cecil D. Sapp (Raytheon Co., Alexandria, Va.). In: *American Society of Photogrammetry, Annual Meeting, 36th, Washington, D.C., March 1-6, 1970, Technical Papers.* Falls Church, Va., American Society of Photogrammetry, 1970, p. 524-532. 8 refs.

Evaluation of K-band side-looking radar (SLR) imagery as a means for mapping tropical lowland vegetation. The interpretation was accomplished through conventional techniques, using tone, texture, and shadowing. The role of collateral data is discussed. SLR and photographic coverage of the Atrato Delta, Colombia, are compared in order to evaluate the utility of radar. 'Signatures' are tabulated. It is concluded that K-band SLR imagery can be useful for tropical lowland vegetation studies. M.V.E.

A70-24754 A method for improving tree measurements from large-scale 70 mm photographs. Seymour Cunningham (New York, State University, Syracuse, N.Y.). In: *American Society of*

Photogrammetry, Annual Meeting, 36th, Washington, D.C., March 1-6, 1970, Technical Papers. Falls Church, Va., American Society of Photogrammetry, 1970, p. 722-728.

Description of a new approach to the collection of forest inventory data by means of large scale 70 mm photography. This new approach involves the creation of a correction surface over the model area of a large-scale pair. From this surface may be derived a correction value for the parallax of any point in the model which, when applied to the measured parallax in the model, will transform that parallax value into the value which would have been obtained if the assumptions of vertical photography had been true. From this corrected parallax value may be calculated an estimate of the scale of the object. M.V.E.

A70-26918 # Relationship of film optical density to yield indicators. Donald H. Von Steen (U.S. Department of Agriculture, Washington, D.C.), Ross W. Leamer, and Alvin H. Gerbermann (U.S. Department of Agriculture, Weslaco, Tex.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 2. Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 1115-1122. NASA Contracts No. R-09-038-001; No. R-09-038-002.

Statistically significant relationships were found between certain preharvest yield indicators and film densities of aerial infrared film in micro experiments. These studies suggest a fixed relationship may exist for important yield components which makes it possible to estimate crop yields with remote sensing techniques. Cotton, grain sorghum, carrots, cabbage, and onions were included in the study. Ground data from small plots improve the estimates made from film density measurements. (Author)

A70-26920 # Discrimination of vegetation by multispectral reflectance measurements. Arthur J. Richardson, William A. Allen, and James R. Thomas (U.S. Department of Agriculture, Weslaco, Tex.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 2. Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 1143-1156. 17 refs.

Discussion of diffuse reflectance and transmittance measurements involving plant leaves over the spectral range from 0.5 to 2.5 micron as a basis for the interpretation of remote sensing data acquired from aircraft and spacecraft. The discrimination criterion used was that of infinite reflectance defined as the maximum reflectance achieved by leaves stacked sufficiently deep. Greenhouse leaves could not be discriminated with respect to known nutritional deficiencies and marginally with respect to species. It is pointed out that discrimination procedures for vegetation based upon appropriate wavelength channels show considerable promise. G.R.

A70-26921 # New multi-stage sampling techniques using space and aircraft imagery for forest inventory. Philip G. Langley (U.S. Department of Agriculture, Berkeley, Calif.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 2.

Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 1179-1192. 7 refs.

A new multi-stage sampling technique, with wide application in earth resource surveys using remote sensing, has been developed and tested on several occasions. For the first time, a complete theory is available with the capability of utilizing information from sample imagery of increasingly finer resolution simultaneously. First-stage samples are selected at random from space or aircraft imagery with probability proportional to a prior prediction as to the relative resource quantity contained in the population units. Increasingly higher resolution imagery is obtained on subsamples within subsequent stages, again with probability proportional to the prediction made at the appropriate stage. Finally, sampling is undertaken on the ground to obtain the necessary ground-truth data. These ground measurements are expanded through the system to obtain estimates that are valid over the entire area of interest. The method has been proven to yield unbiased estimates, and furthermore the sampling error depends solely on the accuracy of the predictions made at each stage. Consequently, the estimates are free of the sampling errors customarily arising by virtue of the inherent variation existing between the raw population units. Allocation formulas have been developed for optimally allocating survey funds to minimize the sampling error for a given fixed cost of the survey. (Author)

A70-26922 # Remote sensing of time dependent phenomena. A. B. Park (U.S. Department of Agriculture, Washington, D.C.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 2. Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 1227-1236.

General discussion of the development of a world-wide crop calendar using repetitive satellite coverage to perform agricultural change detection on a global basis. Patterns of crop location and vegetation periods are examined as problems which must be solved before meaningful world crop production estimates could be obtained. The overlapping of crops in regions where different varieties are grown in close proximity is analyzed. Tables and maps show world crop production statistics. T.M.

A70-26923 # Remote sensing of the arid zone vegetation in the visible spectrum for studying the productivity. B. V. Vinogradov (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 2. Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 1237-1250. 30 refs.

Discussion of the use of remote photometric and spectrometric measurements for estimating plant productivity of grass and shrub vegetation in desert and semidesert environments. The fundamentals of remote sensing are outlined, and it is shown that estimates of vegetation structure and productivity are possible within the spectral region where there is a known relation of reflectance to the projection, density, height, and other characteristics of the plant community. The reflectance characteristics of desert soils are outlined, together with the mosaic features evident in areas of vegetation. The relationships between plant production and aerial film density are discussed, and problems which require further study are outlined. The information which can be gained about the state of the vast desert and semidesert pastures will permit rational cattle breeding, grazing, and pasture prediction. T.M.

A70-26930 # Use of multispectral recognition techniques for conducting rapid, wide-area wheat surveys. R. E. Marshall, N. Thomson, F. Thomson, and F. Krieger (Michigan, University, Ann

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Arbor, Mich.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings, Volume 1.

Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 3-20. Army-USAF-sponsored research; Contract No. NASw-1816.

An experiment was performed to determine the capability of an analog computer system to automatically recognize and map winter wheat and measure its acreage. At the same time, a companion study reported in another paper, (Earing and Ginsberg) was performed to predict, from a library of multispectral signatures, the probability of detection and false detection of wheat in a background statistically similar to that for which actual scanner data were available. The predictions were made for several stages of wheat development of which only two were used for this experimental study because of the limited airborne scanner data available. Statistical comparisons between the predictions and processed results, however, were not within the scope of this study. The airborne scanner data used in this study were obtained on 6 May 1966, and 30 June 1966 over an agricultural area near Lafayette, Indiana, using the University of Michigan multispectral scanner. The data were processed at real-time rates using the analog decision circuitry of a special purpose analog computer. The output was recorded on 70mm strip film to provide maps showing the locations and sizes of all fields detected. The strip maps were analyzed to determine the success of the automatic recognition of winter wheat, as a crop type, for two different stages of the wheat life cycle, and for two different altitudes. Recognition percentages were obtained and causes of non-detection and false detection of wheat were analyzed from ground-truth data and interpretation of aerial photography. (Author)

A70-26931 * # A spectral discrimination technique for agricultural applications. Dianne L. Earing (Michigan, University, Ann Arbor, Mich.) and I. William Ginsberg (Sensors, Inc., Ann Arbor, Mich.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings, Volume 1.

Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 21-32. 6 refs. Contract No. NASw-1816.

The use of analytical models to statistically determine the irradiance expected at a remote sensor from an agricultural area is discussed. The models account for sky irradiance, scene reflectance and atmospheric attenuation in the .4 - 1.0 micron spectral region. Pattern recognition techniques are applied to determine the minimum number of spectral channels required for reasonable probabilities of target detection and false alarm rates. To illustrate these techniques, an example is presented in which the probabilities of detection and false alarms are computed for winter wheat at several stages of growth in a Northern Indiana environment. Good agreement is obtained between the radiances predicted from the models and those measured with an airborne multi-spectral scanner. The results of the study indicate that at some stages of growth, misclassifications can be kept within operational tolerance for a satellite system using three (3) spectral channels. (Author)

A70-26932 # Multispectral imagery and automatic classification of spectral response for detailed engineering soils mapping. Marc G. Tanguay (Ecole Polytechnique, Montreal, Canada), Roger M. Hoffer, and Robert D. Miles (Purdue University, Lafayette, Ind.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings, Volume 1.

Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of

Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 33-63. 10 refs. Research supported by the Indiana State Highway Commission and the Bureau of Public Roads.

Multispectral imagery was obtained with the cooperation of the Willow Run Laboratories, University of Michigan for a 70 mile route in central Indiana. The project, sponsored by the Bureau of Public Roads and the Indiana State Highway Commission, involved the evaluation of imagery taken in fifteen discrete bands of the spectrum as a source of data on engineering soils. The multispectral data was evaluated by (1) visual means, (2) by densitometric measurements and (3) principally with the use of an automatic spectral response classification method developed at the Laboratory for Applications of Remote Sensing (LARS), Purdue University. Classification maps representing seven soil types of different engineering significance were obtained. There is an indication that useful automatic classification of soils can be made and printed on a computer map using multispectral data collected between the ultraviolet and the far infrared range of the spectrum. Information on limited laboratory reflectance measurements is also reported. (Author)

A70-26934 # Inventory of hydrobiological features using automatically processed multispectral data. Milton C. Kolipinski, Aaron L. Higer (U.S. Geological Survey, Miami, Fla.), Norma Spansall Thomson, and Frederick J. Thomson (Michigan, University, Ann Arbor, Mich.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings, Volume 1.

Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 79-92, 94, 95.

Multispectral data were used to map automatically eight different landscape site units in a portion of Everglades National Park in south Florida. By using various combinations of narrow spectral bands from 0.4 to 1.0 micron, it was possible to differentiate and map tree islands, sawgrass grasslands, spikerush grasslands, and two different depths of water. The recognition techniques that were developed employed both digital and analog computing equipment, but the emphasis was on 'fast' processing using analog techniques. The output of the computer was in the form of recognition maps that were printed in several colors and then overlaid to provide a color composite map of the ground features. Data in this form, collected periodically, will be used to determine the direction and extent of successional changes of vegetation in the park and should provide a better basis for water management practices. The success of this study indicates that the multispectral scanning techniques employed in the Everglades have transfer value to other hydrologic situations. (Author)

A70-26937 * # Agricultural and oceanographic applications of multispectral color photography. Edward Yost and Sandra Wenderoth (Long Island University, Greenvale, N.Y.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings, Volume 1.

Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 145-173. 8 refs. Research supported by the U.S. Geological Survey, the U.S. Navy, and NASA.

The theory, design, and applications of a multispectral additive color photographic system are presented. The system is capable of obtaining photography in any four bands covering the .36 to .9 micron region of the spectrum and optically projecting the resulting four spectral positives to form a single color presentation. Agricultural experiments over controlled test sites, in which measurements of incident and reflected solar radiation were obtained simul-

taneously with the spectral photography, indicate that the system can compensate for solar and atmospheric effects to produce a unique signature for many crops and tree species. This multispectral color photographic technique is also useful in obtaining accurate measurements of phytoplankton concentrations and suspended non-organic particulate matter in coastal waters. (Author)

A70-28108 A methodology for the automated photo-identification of rural land use types. Dieter Steiner (Zürich, Universität, Zurich, Switzerland). In: Automatic interpretation and classification of images; NATO, Summer School, Pisa-Tirrenia, Italy, August 26-September 6, 1968, Proceedings. Edited by Antonio Grasselli. New York, Academic Press, Inc., 1969, p. 235-241. 14 refs.

Investigation of methodological aspects concerning the machine identification of individual crop types. The application of discriminant analysis to photo crop identification is discussed. Classifications based on single variables are considered. The classification accuracy is improved by adding more information. Data gathering was extended to the time dimension and measurements were made on photos taken at two different times of the year. G.R.

A70-30980 Color and IR photos for soils. Arthur D. Kuhl (Cornell University, Ithaca, N.Y.; U.S. Department of Agriculture, Washington, D.C.). *Photogrammetric Engineering*, vol. 36, May 1970, p. 475-482. 13 refs.

A quantitative method measured the accuracy of interpreting soil characteristics from black-and-white, infrared, and color aerial photos of selected sites in Onondaga County, New York. These sites represent a diverse set of soil forming conditions, soil parent materials, and several types of vegetative cover. Color and infrared photos were better than black-and-white photos in interpreting soil drainage and slope. (Author)

A70-30981 Forest cover type identification. Kenneth G. Northrop (Tennessee Valley Authority, Tenn.) and Evert W. Johnson (Auburn University, Auburn, Ala.). *Photogrammetric Engineering*, vol. 36, May 1970, p. 483-490. Research supported by the Auburn University.

Description of the results of a study designed to determine how well forest cover types in an area of mixed hardwoods and pine could be identified on medium scale aerial photographs. The results indicate that more information about forest cover can be obtained from aerial photographs of medium scale than has previously been thought possible. M.V.E.

A70-31233 Reflectance of single leaves and field plots of Cycocel-treated cotton (*Gossypium hirsutum* L.) in relation to leaf structure. H. W. Gausman, W. A. Allen, V. I. Myers, R. Cardenas, and R. W. Leamer (U.S. Department of Agriculture, Agricultural Research Service, Weslaco, Tex.). *Remote Sensing of Environment*, vol. 1, Mar. 1970, p. 103-107. 22 refs. NASA-supported research.

Discussion of field experiments in which cotton plant leaves were sprayed with 100 g/ha Cycocel in order to determine the effect of this treatment on the tonal responses of aerial IR photographs of cotton plots. Laboratory measurements of near infrared reflectance at 750 to 1350 mμ indicated that reflectance was higher in Cycocel-treated plants than in control plants, due to the expansion of intercellular air spaces in leaf mesophylls by Cycocel. The chlorophyll content and thus absorption of light at 500 to 750 mμ were also higher after Cycocel spraying. The tonal response on Ektachrome IR aerofilm was a darker red for Cycocel-treated plots than for control plots. V.Z.

A70-31237 Using radar imagery for drop discrimination - A statistical and conditional probability study. R. M. Haralick, F. Caspall, and D. S. Simonett (Kansas University, Lawrence, Kan.).

Remote Sensing of Environment, vol. 1, Mar. 1970, p. 131-142. 10 refs. Research supported by the University of Kansas; U.S. Geological Survey Contract No. 14-08-0001-12077; Grant No. DA-AK-02-68-C-0089; Contract No. NAS 9-7175.

A number of the constraints with which remote sensing must contend in crop studies are outlined. They include sensor, identification accuracy, and congruencing constraints; the nature of the answers demanded of the sensor system; and the complex temporal variances of crops in large areas. Attention is then focused on several methods which may be used in the statistical analysis of multidimensional remote sensing data. Crop discrimination for radar K-band imagery is investigated by three methods. The first one uses a Bayes decision rule, the second a nearest-neighbor spatial conditional probability approach, and the third the standard statistical techniques of cluster analysis and principal axes representation. Results indicate that crop type and per cent of cover significantly affect the strength of the radar return signal. Sugar beets, corn, and very bare ground are easily distinguishable, sorghum, alfalfa, and young wheat are harder to distinguish. Distinguishability will be improved if the imagery is examined in time sequence so that changes between times of planning, maturation, and harvest provide additional discriminant tools. A comparison between radar and photography indicates that radar performed surprisingly well in crop discrimination in western Kansas and warrants further study. (Author)

A70-31667 # Visible polarization signature for remote sensing of soil surface moisture. L. Steg and R.T. Frost (GE Space Sciences Laboratory, Philadelphia, Pa.). *COSPAR, Plenary Meeting, 13th, Leningrad, USSR, May 20-29, 1970, Paper*. 15 p.

Review of laboratory and field measurements of the visible polarization signature and discussion of the latter's relation to the surface moisture of soils. It is shown that the enhancement in polarization allows quantitative determination of surface moisture. The signatures are invariant to partial shadowing encountered in plowed or rough soils and indicate little dependence on soil type. Calculations based on the measurements suggest the possibility of moisture discrimination in the visible region when viewing through the atmosphere including standard haze models. M.V.E.

A70-34047 * Detecting tree moisture stress. Wayne G. Rohde and Charles E. Olson, Jr. (Michigan University, Ann Arbor, Mich.). (*American Society of Photogrammetry, Annual Meeting, 35th, Washington, D.C., Mar. 9-14, 1969.*) *Photogrammetric Engineering*, vol. 36, June 1970, p. 561-566. 12 refs. NASA-supported research.

During 1968, several oak (*Quercus* spp.), red maple (*Acer rubrum*) and balsam poplar (*Populus balsamifera*) within test plots on an upland forest site were girdled with a chain saw to create locations of known moisture stress. Day and night thermal infrared imagery in the 8 to 14 micrometer region was obtained in May. In July, day and night thermal infrared imagery was obtained in the 8 to 14 and 4.5 to 5.5 micrometer regions. Color and black and white photographs, both panchromatic and infrared, were also obtained in July. Girdled plots were detectable on all infrared imagery obtained in July. However, girdled trees on upland sites would not have been detected on any nighttime thermal infrared imagery if their exact locations had not previously been known. (Author)

A70-35611 Remote sensing in ecology; Ecological Society of America and American Society of Limnology and Oceanography, Symposium, Madison, Wis., June 19, 1968, Proceedings. Edited by P. L. Johnson. Athens, Ga., University of Georgia Press, 1969. 256 p. \$8.00.

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and C. J. Johannsen (Purdue University, West Lafayette, Ind.), p. 1-16. 15 refs.

Leaf reflectance and image formation on color infrared film. E. B. Knipling (U.S. Department of Agriculture, Gainesville, Fla.), p. 17-29. 30 refs.

Large-scale color photography reflects changes in a forest community during a spruce budworm epidemic. R. C. Aldrich and R. C. Heller (U.S. Forest Service, Berkeley, Calif.), p. 30-45. 7 refs.

Ecological applications of multispectral color aerial photography. E. Yost and S. Wenderoth (Long Island University, Greenvale, N.Y.), p. 46-62. 5 refs.

A multi-sensor study of plant communities at Horsefly Mountain, Oregon. R. M. Peterson, G. R. Cochrane, S. A. Morain, and D. S. Simonett (Kansas University, Lawrence, Kan.), p. 63-94. 11 refs.

Infrared measurement of plant and animal surface temperature and their interpretation. D. M. Gates (Missouri Botanical Garden, St. Louis, Mo.), p. 95-107.

Analysis of environmental and vegetative gradients in Yellowstone National Park from remote multispectral sensing. L. D. Miller (Colorado State University, Fort Collins, Colo.) and C. F. Cooper (Michigan University, Ann Arbor, Mich.), p. 108-131. 22 refs.

Observations on interpretation of vegetation from infrared imagery. D. K. Weaver, W. E. Butler, and C. E. Olson, Jr. (Michigan University, Ann Arbor, Mich.), p. 132-137. (See A70-35618 17-13)

Progress in large animal census by thermal mapping. D. R. McCullough, C. E. Olson, Jr. (Michigan University, Ann Arbor, Mich.), and L. M. Queal (Kansas Forestry, Fish and Game Commission, Garnett, Kan.), p. 138-147.

Portable radios in determination of ecological parameters of large vertebrates with reference to deer. R. L. Marchinton (Georgia University, Athens, Ga.), p. 148-163.

The significance of spectral changes in light scattered by the sea. G. L. Clarke (Harvard University, Cambridge, Mass.), p. 164-172. 7 refs.

Aerial photographic studies of shallow water benthic ecology. M. G. Kelly (New York University, University Heights, N.Y.) and A. Conrod (MIT, Cambridge, Mass.), p. 173-184. 7 refs.

Surface temperature patterns of Hudson Bay from aerial infrared surveys. W. M. Wendland and R. A. Bryson (Wisconsin University, Madison, Wis.), p. 185-193. 13 refs.

How multispectral sensing can help the ecologist? F. C. Polcyn, N. A. Spansail, and W. A. Malida (Michigan University, Ann Arbor, Mich.), p. 194-218. 10 refs.

Resume. P. L. Johnson, p. 219-223.

Selected bibliography, p. 224-244.

A70-35612 * Ecological potentials in spectral signature analysis. R. M. Hoffer and C. J. Johannsen (Purdue University, West Lafayette, Ind.). In: Remote sensing in ecology; Ecological Society of America and American Society of Limnology and Oceanography, Symposium, Madison, Wis., June 19, 1968, Proceedings.

Edited by P. L. Johnson. Athens, Ga., University of Georgia Press, 1969, p. 1-16. 15 refs. Research supported by the U.S. Department of Agriculture and NASA.

Attempt to show, with the use of leaf and soil spectra, the utility of laboratory spectral reflectance data for interpretation of ecological potentials in spectral signature analysis. The portion of the spectrum where the greatest difference in reflectance among various plant and soil materials occurs can be determined, and the effects of differences in moisture content, pigmentation, and internal leaf structure can be studied. It is considered that laboratory studies are a very necessary step in developing an understanding of energy interactions with plant and soil materials. It is stressed that a capability for differentiating plant or soil materials on the basis of laboratory spectra does not mean that the same results will be obtained in the field. F.R.L.

A70-35613 Leaf reflectance and image formation on color infrared film. Edward B. Knipling (U.S. Department of Agriculture, Soil and Water Conservation Research Div., Gainesville, Fla.). In: Remote sensing in ecology; Ecological Society of America and American Society of Limnology and Oceanography, Symposium, Madison, Wis., June 19, 1968, Proceedings. Edited by P. L. Johnson. Athens, Ga., University of Georgia Press, 1969, p. 17-29. 30 refs.

Study of false color aerial photography with Ektachrome Infrared Aero film, which has been found useful for distinguishing vegetation types and assessing plant vigor. Healthy green leaves have a low visible and high infrared reflectance, and characteristically appear bright red on color infrared photographs. Physiological disturbances to plants generally are accompanied by increases in the visible reflectance, but the direction of change in infrared reflectance is quite variable. Thus, deviations from the red color on photographs are not always explained by a decline in infrared reflectance. Disease, damage, and physiological stresses in plants influence the extent of red coloration by changing the geometry and density of foliage as much as by changing the reflectance characteristics of individual leaves. F.R.L.

A70-35614 Large-scale color photography reflects changes in a forest community during a spruce budworm epidemic. R. C. Aldrich and R. C. Heller (U.S. Forest Service, Berkeley, Calif.). In: Remote sensing in ecology; Ecological Society of America and American Society of Limnology and Oceanography, Symposium, Madison, Wis., June 19, 1968, Proceedings. Edited by P. L. Johnson. Athens, Ga., University of Georgia Press, 1969, p. 30-45. 7 refs.

Discussion of large-scale aerial photographs taken annually during a 10-yr period over several spruce fir stands in northeastern Minnesota. The photographs were used primarily to develop aerial photographic sampling techniques for assessing damage caused by the spruce budworm. A secondary purpose was to follow the history of mature spruce fir stands during and following an epidemic. The color photography provided a good assessment of changes in balsam fir density, and permitted identification of boreal tree species with high accuracy. Photographs based on photo images showed differences in species frequency, composition, and cloud cover. F.R.L.

A70-35615 Ecological applications of multispectral color aerial photography. Edward Yost and Sondra Wenderoth (Long Island University, Greenvale, N.Y.). In: Remote sensing in ecology; Ecological Society of America and American Society of Limnology and Oceanography, Symposium, Madison, Wis., June 19, 1968, Proceedings. Edited by P. L. Johnson. Athens, Ga., University of Georgia Press, 1969, p. 46-62. 5 refs.

Description of a remote sensing experiment (summer 1967) which demonstrated the utility of multispectral color aerial photography to the environmental sciences. The ability to detect and identify basic ecological parameters is most significant. The possibility of eliminating instrumentation errors which have hitherto plagued the technology has been achieved, as well as a reduction of the effects of environmental variables. The data collected indicate that the near infrared spectrum apparently offers significant possibilities for detection of differences among vegetative species. Particularly, subdivision of the spectral band ranging from 680 to 900 millimicron seems to offer promise for establishing unique chromatic differences in the images of living vegetation. F.R.L.

A70-35616 A multi-sensor study of plant communities at Horsefly Mountain, Oregon. Rex M. Peterson, G. Ross Cochrane, Stanley A. Morain, and David S. Simonett (Kansas University, Lawrence, Kan.). In: Remote sensing in ecology; Ecological Society of America and American Society of Limnology and Oceanography, Symposium, Madison, Wis., June 19, 1968, Proceedings.

Edited by P. L. Johnson. Athens, Ga., University of Georgia Press, 1969, p. 63-94. 11 refs. Research supported by the U.S. Geological Survey; Grant No. DA-AK-02-68-C-0089.

Use of several photographic and other forms of sensor imagery, augmented by field survey, to map vegetation communities. Techniques used included differentiation, level selection, combination, and texture discrimination for recognizing vegetation boundaries and density differences both within and between plant communities. The photographs were compared with panchromatic and Ektachrome vertical aerial photos and a forestry map of the region. The studies demonstrate that in addition to IDECS (image discrimination, enhancement, combination, and sampling system) discrimination of boundaries and densities in natural vegetation, combinations of imagery using the near infrared were usually better than those where it was not present. It is suggested that radar can serve a useful function in vegetation mapping. F.R.L.

A70-35617 Analysis of environmental and vegetative gradients in Yellowstone National Park from remote multispectral sensing. Lee D. Miller (Colorado State University, Fort Collins, Colo.) and Charles F. Cooper (Michigan, University, Ann Arbor, Mich.). In: Remote sensing in ecology; Ecological Society of America and American Society of Limnology and Oceanography, Symposium, Madison, Wis., June 19, 1968, Proceedings. Edited by P. L. Johnson. Athens, Ga., University of Georgia Press, 1969, p. 108-131. 22 refs.

Determination of the application of remote multispectral sensing techniques to obtaining synoptic information of ecological significance. The study sites were located by an intercomparison of thermal and visible band imagery. The unusual nature of the sites (steaming ground) necessitated an extensive and continuing study of the energy and biological relationships existing in the test area. The potential usefulness of thermal imagery to extrapolate information collected on control sites to larger areas is demonstrated. F.R.L.

A70-35618 Observations on interpretation of vegetation from infrared imagery. David K. Weaver, William E. Butler, and Charles E. Olson, Jr. (Michigan, University, Ann Arbor, Mich.). In: Remote sensing in ecology; Ecological Society of America and American Society of Limnology and Oceanography, Symposium, Madison, Wis., June 19, 1968, Proceedings. Edited by P. L. Johnson. Athens, Ga., University of Georgia Press, 1969, p. 132-137.

Study of available imagery of two areas near Ann Arbor, Mich., with a view to determining the relative merits of day and night infrared imagery for interpreting vegetation. Analysis of the data indicates that nighttime imagery provides the best separation of vegetation in swamps and other areas where the water table is close to the surface. For areas of high ground, including most agricultural areas, imagery obtained in mid-afternoon when daily water stress is greatest seems distinctly superior to nighttime imagery. F.R.L.

A70-39062 User needs in agriculture and forestry. A. B. Park (U.S. Department of Agriculture, Research Management Group, Washington, D.C.). In: Princeton University, Conference on Aerospace Methods for Revealing and Evaluating Earth's Resources, Princeton University, Princeton, N.J., September 25, 26, 1969, Proceedings. Edited by J. P. Layton. Princeton, N.J., Princeton University Conference, 1970, p. 13.1-13.9, 13.11-13.23; Discussion, p. 13.24-13.26.

Discussion of the data which can be obtained by the Earth Resources Technology Satellite (ERTS) in answer to user needs in agriculture and forestry. Requirements of the Agricultural Stabilization and Conservation Service regarding the control of crop acreage are discussed, and the needs of the Soil Conservation Service are examined. The objectives of the Statistical Reporting Service, of the Economic Research Service, and of the Agricultural Research Service are investigated. G.R.

A70-39067 Agricultural resource information requirements of nongovernmental users. Harold G. Lorsch (General Electric Co., Aerospace Group, New York, N.Y.). In: Princeton University, Conference on Aerospace Methods for Revealing and Evaluating Earth's Resources, Princeton University, Princeton, N.J., September 25, 26, 1969, Proceedings. Edited by J. P. Layton. Princeton, N.J., Princeton University Conference, 1970, p. 20.1-20.17.

Results of a survey among more than 40 people in 16 organizations for the purpose of obtaining information on which to base a preliminary design for an aircraft/spacecraft assisted agricultural resource information system. It appears that interviews are effective in identifying information requirements of agribusiness users, and remote sensing can satisfy many needs of the agribusiness community. F.R.L.

A70-42767 Physical and physiological basis for the reflectance of visible and near-infrared radiation from vegetation. Edward B. Knipling (U.S. Department of Agriculture, Agricultural Research Service, Gainesville, Fla.). *Remote Sensing of Environment*, vol. 1, Summer 1970, p. 155-159. 28 refs.

Discussion of the physical and physiological basis for the reflection of visible and near-infrared solar radiation from plant leaves and vegetation canopies pertinent to information about agricultural crops, forests, and range. A plant leaf typically has a low reflectance in the visible spectral region because of strong absorption by chlorophylls, a relatively high reflectance in the near infrared because of internal leaf scattering and no absorption, and a relatively low reflectance in the infrared beyond 1.3 microns because of strong absorption by water. The reflectance of a plant canopy is similar, but is modified by the nonuniformity of incident solar radiation, plant structures, leaf areas, shadows, and background reflectivities. Airborne sensors receive an integrated view of all these effects, and each crop of vegetation type tends to have a characteristic signature which permits its discrimination. When disease and physiological stresses directly affect the reflectance properties of individual leaves, the most pronounced initial changes often occur in the visible spectral region rather than in the infrared because of the sensitivity of chlorophyll to physiological disturbances. M.V.E.

A71-11590 # Machine-aided photo interpretation techniques for vegetation analysis. J. D. Lent and J. D. Nichols (California, University, Berkeley, Calif.). (*American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-308.*) *Journal of Spacecraft and Rockets*, vol. 7, Nov. 1970, p. 1362-1365.

Exploration of some of the capabilities which various remote systems offer, in terms of spatial resolution and user requirements, for obtaining rapid land-use inventories. This is accomplished by a discussion of machine-aided analytical techniques for data reduction and analysis. The discussion is compared with its counterpart in conventional photo interpretation techniques and results. With respect to vegetation-oriented resource inventories in the U.S., the land-use manager is mainly concerned with the categories of agriculture, forests, rangelands, and brushlands. It is considered that scanning microdensitometry and appropriate software analysis can be of great assistance to the human interpreter's overall task. F.R.L.

A71-17145 Texture as a discriminant of crops on radar imagery. David H. Berger (Kansas, University, Lawrence, Kan.). (*Institute of Electrical and Electronics Engineers, Annual International Geoscience Electronics Symposium, 2nd, Washington, D.C., Apr. 14-17, 1970.*) *IEEE Transactions on Geoscience Electronics*, vol. GE-8, Oct. 1970, p. 344-348. 9 refs. Research supported by the U.S. Geological Survey.

Density, contrast, and contrast frequency were tested as textural attributes of wheat, sorghum, alfalfa, wheat stubble, and weeds, all

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crops having similar average density values on multipolarization K-band radar imagery but dissimilar plant geometries. Fifty-three microphotographs of fields displayed on Hedenheim (HH) imagery were scanned with a transmission densitometer, and contrast frequency values were derived. These measures did not yield significantly more information than that obtained in previous studies. It is, nevertheless, felt that texture and its associated attributes can often serve as reliable discriminants of crops and other areal extensive objects and contribute to the solution of automatic pattern recognition problems. (Author)

A71-18405 Aerospace science and agricultural development; American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America, Annual Meeting, Detroit, Mich., November 9-14, 1969, Proceedings. Edited by M. F. Baumgardner (Purdue University, Lafayette, Ind.). Madison, Wis., American Society of Agronomy (ASA Special Publication Series, No. 18), 1970. 52 p. \$3.00.

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Aerospace systems to serve agriculture. A. B. Park (NASA, Earth Observations Programs, Washington, D.C.), p. 1-7.

Remote sensing techniques used in agriculture today. M. F. Baumgardner (Purdue University, Lafayette, Ind.), R. W. Leamer (U.S. Department of Agriculture, Weslaco, Tex.), and J. R. Shay (Oregon State University, Corvallis, Ore.), p. 9-26. 27 refs.

Development of an aerospace system for agriculture. T. J. Army, S. M. King (International Minerals and Chemicals Corp., Libertyville, Ill.), and R. O. Aines, p. 27-35. 6 refs.

Accelerating international agricultural development with aerospace remote sensing. D. L. McCune (Tennessee Valley Authority, Muscle Shoals, Ala.), p. 37-48.

A71-18406 * # Aerospace systems to serve agriculture. Arch B. Park (NASA, Earth Observations Programs, Washington, D.C.). In: Aerospace science and agricultural development; American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America, Annual Meeting, Detroit, Mich., November 9-14, 1969, Proceedings. Edited by M. F. Baumgardner. Madison, Wis., American Society of Agronomy (ASA Special Publication Series, No. 18), 1970, p. 1-7.

Discussion of applications of remote sensing to agriculture and forestry. These applications are based on the measurements which can now be made with airborne sensors. It has been found that most vegetation and soils can be identified on the basis of their spectral signatures in the 0.25 to 15-micron region. Such recognition techniques permit crop censusing and land use determination. Applications of the results of remote sensing studies are discussed, including government compliance checking, crop forecasts, range surveys to aid in assessing carrying capacity, soil mapping, detection of crop diseases and insect infestation, watershed and forest inventory, and the detection of forest fires and forest fire hazard levels. G.R.

A71-18407 * # Remote sensing techniques used in agriculture today. Marion F. Baumgardner (Purdue University, Lafayette, Ind.); Ross W. Leamer (U.S. Department of Agriculture, Agricultural Research Service, Weslaco, Tex.), and J. Ralph Shay (Oregon State University, Corvallis, Ore.). In: Aerospace science and agricultural development; American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America, Annual Meeting, Detroit, Mich., November 9-14, 1969, Proceedings. Edited by M. F. Baumgardner. Madison, Wis.,

American Society of Agronomy (ASA Special Publication Series, No. 18), 1970, p. 9-26. 27 refs.

Discussion of remote sensing techniques and their applications to agronomic research. Spatial, spectral, and temporal measurements which can be made with the use of the EM spectrum are discussed. It is pointed out that computer programs have been developed to recognize various crops, soil cover, and soil condition categories from optical density measurements of the layers of color film. Multi-spectral response studies of soils and plants conducted with a laboratory spectroradiometer and investigations with an airborne optical mechanical scanner are discussed. Applications of remote sensing considered include vegetation studies, soil studies, water studies, and meteorology. A brief outlook into future applications is given covering determination of soil moisture and of microclimatic features. G.R.

A71-18408 # Development of an aerospace system for agriculture. Thomas J. Army, S. MacCallum King (International Minerals and Chemicals Corp., Libertyville, Ill.), and Ronald O. Aines. In: Aerospace science and agricultural development; American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America, Annual Meeting, Detroit, Mich., November 9-14, 1969, Proceedings. Edited by M. F. Baumgardner. Madison, Wis., American Society of Agronomy (ASA Special Publication Series, No. 18), 1970, p. 27-35. 6 refs.

Discussion of the development of an improved agricultural information and advisory service based on technological advances in both remote sensing and computer sciences and making use of satellites and aircraft. A three-pronged approach to the development of an aerospace information system for midwestern agriculture as a first step is discussed. The three essential components of this proposed effort are a research program, a pilot applications system utilizing aircraft and satellites, and a user educational-involvement program. The research program will need to be sufficiently general to investigate effective data distribution and utilization as well as data acquisition. A program for managing agricultural resources through data obtained via remote sensing is to be tested. G.R.

A71-18409 # Accelerating international agricultural development with aerospace remote sensing. Donald L. McCune (Tennessee Valley Authority, Muscle Shoals, Ala.). In: Aerospace science and agricultural development; American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America, Annual Meeting, Detroit, Mich., November 9-14, 1969, Proceedings. Edited by M. F. Baumgardner. Madison, Wis., American Society of Agronomy (ASA Special Publication Series, No. 18), 1970, p. 37-48.

Discussion of the benefits which could be derived from a worldwide remote sensing system using satellites or high-flying aircraft in connection with computer data-processing techniques giving particular attention to advantages for the less developed areas of the world. The importance of a full acceptance of such a system by the nations of earth is pointed out, and organizational approaches for creating such a system through the UN are considered. Worldwide potentials of aerospace remote sensing are examined taking into consideration the availability of new improved equipment. Various fields which would benefit from a global remote sensing system are discussed including weather forecasting, survey of world crops, national and regional planning, vegetation mapping, characterization and mapping of soils, inventory of water resources, monitoring irrigation agriculture, and animal agriculture. G.R.

A71-21436 * Multibase and multiemulsion space photos for crops and soils. G. L. Wiegand, R. W. Leamer, D. A. Weber, and A. H. Gerbermann (U.S. Department of Agriculture, Agricultural Research Service, Weslaco, Tex.). *Photogrammetric Engineering*, vol. 37, Feb. 1971, p. 147-156. 7 refs. NASA Contract No. R-09-038-002.

Description of the results of a study to computerize the identification of crop species and soil conditions from film optical density differences where ground truth of fields was available. Some of the conclusions drawn from the study are: (1) multibase and multiemulsion photography are about equally useful for crop and soil condition discrimination; (2) on the multiemulsion Ektachrome IR film the categories are most easily discriminated using the no-minus-red, the red-minus-green, and the red-minus-blue bandpass-filtered optical-density differences. For the three black-and-white films, the optical-density differences between the red band image and the IR image were most useful to distinguish categories; and (3) the crop categories are more difficult to distinguish from each other than from the bare and salt flat soil conditions. M.M.

A71-21437 Air photo analysis of beef and dairy farming. Robert A. Ryerson and Harold A. Wood (McMaster University, Hamilton, Ontario, Canada). *Photogrammetric Engineering*, vol. 37, Feb. 1971, p. 157-169.

Using, as a point of departure, recommended feeding systems for cattle of different types and the ways in which cattle are housed within barns, it has been possible, using air photo interpretation, to determine, with an average level of accuracy greater than 92%, whether a cattle-raising farm in Southern Ontario has a dairy or a beef emphasis and how many cattle are kept on the farm. The methodology can be applied quite satisfactorily using ordinary black-and-white panchromatic photographs provided that the photo scale permits the measurement of building dimensions to an accuracy of approximately two feet and provided that they were taken at a time of year which permits an interpreter to identify corn, small grains, hay, improved pasture, and rough pasture. (Author)

A71-23209 The delineation of forest cover and site parameters by multiband remote sensing. Paul F. Krumpke, H. R. DeSelm, and Clifford C. Amundsen (Tennessee, University, Knoxville, Tenn.). In: American Society of Photogrammetry, Annual Meeting, 37th, Washington, D.C., March 7-12, 1971, Technical Papers.

Falls Church, Va., American Society of Photogrammetry, 1971, p. 98-122. 23 refs.

Attempt to detect landscape characteristics of a forested area, and to establish relationships using remotely sensed imagery where ground truths had been established. The study is part of continuing research to acquire base-line information and techniques to characterize, predict, and map vegetation and site parameters in the southern Appalachians. Ground control was achieved using both area and point samples. A key to overstory tree taxa was developed employing Ektachrome color data and 33 crown characteristics. Predictive equations relating imagery data to corresponding field-determined crown closure, plot density, crown size classes, and other characteristics have been developed. These relationships as well as those among site and site-vegetation characteristics are employed in the development of automated scanning techniques for analysis and cover mapping of qualitative and quantitative landscape characteristics. F.R.L.

A71-23210 * Remote sensing with optical-mechanical line scanners to detect stress in forests. F. P. Weber (U.S. Department of Agriculture, Forest Service, Berkeley, Calif.) and F. C. Polcyn (Michigan, University, Ann Arbor, Mich.). In: American Society of Photogrammetry, Annual Meeting, 37th, Washington, D.C., March 7-12, 1971, Technical Papers. Falls Church, Va., American Society of Photogrammetry, 1971, p. 123-152. 25 refs. Research supported by the U.S. Department of Health, Education, and Welfare and NASA.

Description of the applications of airborne multispectral remote sensing and the potential of automatic multispectral processing for previsual detection of damage from insect infestations, disease organisms, and oxidant air pollution. Optical-mechanical line scanners flown over instrumented ground test sites in several different

forest communities collected 18 discrete channels of remote sensing data between 0.4 and 13.5 micrometers. Reflective and emissive differences among stress-induced trees were well documented from ground measurements. F.R.L.

A71-23211 The collection of crop and land use data around the world - A task for remote sensing. Simon Baker (Florida Atlantic University, Boca Raton, Fla.). In: American Society of Photogrammetry, Annual Meeting, 37th, Washington, D.C., March 7-12, 1971, Technical Papers. Falls Church, Va., American Society of Photogrammetry, 1971, p. 153-161.

Examination of a world sample of 34 countries as to the adequacy and need for better data on crop areas, yield, production, and land use. The need for such data is great, and it is concluded that traditional techniques for gathering them are too slow and in many cases cannot be organized on time. The use of remote sensing devices and procedures is recommended. F.R.L.

A71-29394 * Color and color-IR films for soil identification. A. H. Gerbermann, H. W. Gausman, and C. L. Wiegand (U.S. Department of Agriculture, Welaco, Tex.). *Photogrammetric Engineering*, vol. 37, Apr. 1971, p. 359-361, 363, 364. 6 refs. NASA-supported research.

Ektachrome Infrared Aero Film 8443 (EIR) and Kodak Ektachrome Aero Film 8442 (CC) were tested for use in identifying soil types. Twelve air-dried soils, differing in Munsell color designations, were photographed with the CC and EIR films. Optical density measurements were made on film transparencies with a densitometer using red-, green-, blue-, and white-light band-pass filters. Duncan's statistical test indicates that the soils can be separated into two groups: soils with a low chroma (soils grey or neutral in color), which are distinguished best with EIR film, and soils with high chroma (soils with high color), which are distinguished easiest with CC film. Optical densities measured using red filters discriminated best among low chroma soils, while optical densities obtained with blue filters discriminated best among the high chroma soils. (Author)

A71-29398 Space photos for land use and forestry. Robert C. Aldrich (U.S. Forest Service, Berkeley, Calif.). *Photogrammetric Engineering*, vol. 37, Apr. 1971, p. 389-401. 11 refs.

Infrared-color film taken as part of NASA's Apollo 9 multiband space photography experiment was the best of four film-filter combinations tested, to separate forests from other land uses. Interpretation of forest on infrared-color is based on color (hue, value, and chroma) and texture; the minimum ground resolution was found to be 300 feet. Automated interpretation of forest area may be feasible in the future because relative differences in film density appear to be related to land use. Results of a multistage forest inventory on two 5-million acre areas were conflicting. Information on the space photographs reduced the sampling error by 58 percent for an inventory in the Mississippi valley, but no such reduction was achieved in a similar inventory in Georgia. (Author)

A71-30576 Disease - Assessment with IR-color. V. R. Wallen and L. E. Philpotts (Department of Agriculture, Ottawa, Canada). *Photogrammetric Engineering*, vol. 37, May 1971, p. 443-446.

A method was developed to evaluate the percentage of diseased plants per field from aerial IR-color photography. The method requires the tracing of infected areas of a field onto a cellulose acetate sheet coated with Krylon. Finally autopoitive copies of the field size and other copies of the infected areas are placed side by side on 4 x 4-foot paper. The 4 x 4-foot sheet is scanned on an IBM drum scanner originally designed for the Canadian Land Inventory and the information is recorded on magnetic tape. One sq in. of area is subject to 62,500 recordings and, depending on the photographic

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scale, each 1.4 to 7.8 sq feet of a given field is scanned with the technique. Yields of the fields were also recorded in an attempt to obtain a disease-yield loss evaluation. (Author)

A71-30924 * A Doppler satellite system design for animal tracking. J. C. Maxwell (Smithsonian Institution, Washington, D.C.). In: NTC '71; Institute of Electrical and Electronics Engineers, National Telemetering Conference, Washington, D.C., April 12-15, 1971, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 259-263. 7 refs. Contract No. NASw-1983.

The Doppler effect enables satellites to locate crystal-controlled CW transmitters on the surface of the earth and thus can be used to track animals. With no thermal insulation, bird transmitters radiating 4 mW at 1.91 m can be located to within 30 km. With thermal insulation, larger animal transmitters radiating 4 mW at 1.91 m, 76.4 mW at 0.6 m, 85.6 mW at 0.4 m, 76.0 mW at 0.3 m, or 160 mW at 0.15 m can be located to within 2 km. The transmitters are identified by using 10 different frequencies between 157 MHz and 2 GHz. The satellite receiver and associated equipment are estimated to weigh 8.25 lb and occupy 278 cu in. Phase-lock loop tracking filters, followed by digital counters, are used to measure the satellite Doppler frequency. A signal acquisition probability of 0.99 for the larger animals and 0.90 for birds is obtained. A signal-lock indication provides for the tagging of each 1-sec Doppler point. Up to 80% of the 5-min Doppler curve can be rejected without affecting the location accuracy. (Author)

A71-34272 Aerial color in forestry. Bernard W. Hostrop and Tad Kawaguchi (U.S. Forest Service, Ogden, Utah). *Photogrammetric Engineering*, vol. 37, June 1971, p. 555-561, 563.

The significance of and the problems inherent in aerial color photography employed in national forest administration are discussed. Functions of aerial photography in forestry are outlined, and a review is presented of the efforts made so far by the Engineering's Surveys and Maps Branch to improve the quality of processing color aerial photographs. Finally, the value of aerial color in providing increased technical detail in forestry as compared with black-and-white photographs is considered. O.H.

A71-34274 * Multispectral color for agriculture and forestry. Edward Yost and Sondra Wenderoth (Long Island University, Greenvale, N.Y.). *Photogrammetric Engineering*, vol. 37, June 1971, p. 590-597, 599, 601-604. 8 refs. Contract No. NAS 9-7291.

The potential usefulness of multispectral color photography for the identification of crop and tree species has been demonstrated in a series of controlled experiments using broad-band camera filters which approximate the spectral sensitivity of color and color-infrared films. Independent adjustment of exposure in each camera band, control over the gamma and density of the photographic image, along with the ability to adjust the hue, brightness, and saturation in viewing, resulted in greater image chromatic separation than could be achieved using subtractive color reversal films. The capability to compensate for variations in the solar illuminant and atmospheric attenuation using additive color viewing of multispectral photographs was demonstrated. (Author)

A71-36365 * 'Vegetation penetration' with K-band imaging radars. William P. Waite and Harold C. MacDonald (Arkansas University, Fayetteville, Ark.). *IEEE Transactions on Geoscience Electronics*, vol. GE-9, July 1971, p. 147-155. 15 refs. Grant No. DA-AK-02-68-C-0089; Contract No. NAS 9-10261.

Data analysis suggesting that for defoliated vegetation, the penetrative effects of Ka-band radar energy can be recognized on the

imagery format. Boundaries may be defined on the radar imagery that are directly related to differences in soil moisture content, irrespective of either the vegetation type or density. Use is made of the depolarized return signal to distinguish between differences due to soil moisture and gross vegetation differences, thus providing a practical advantage for a multipolarization mode. (Author)

A71-38409 A managerial decision system for an airborne infrared fire detection device. William G. O'Regan (U.S. Forest Service; California, University, Berkeley, Calif.) and Peter Kourtz (Department of Fisheries and Forestry, Ottawa, Canada). In: Engineering for the conservation of mankind; Institute of Electrical and Electronics Engineers, Region Six Conference, Sacramento, Calif., May 11-13, 1971, Conference Record. Edited by M. G. Jerome and Joyce Guthrey, Sacramento, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 6B-1.1 to 6B-1.5. 6 refs.

Some details are given of the design and construction of a simulator to be used in deriving decision rules for the control of an infrared forest fire detection system. The results of some experiments are given, and some tentative control procedures are suggested. (Author)

A71-38410 A new system for detecting latent forest fires. Forrest H. Madden (U.S. Forest Service, Northern Forest Fire Laboratory, Missoula, Mont.). In: Engineering for the conservation of mankind; Institute of Electrical and Electronics Engineers, Region Six Conference, Sacramento, Calif., May 11-13, 1971, Conference Record. Edited by M. G. Jerome and Joyce Guthrey, Sacramento, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 6B-2.1 to 6B-2.8. 7 refs.

Description of an airborne IR forest fire surveillance system capable of locating incipient forest fires at night or when smoke and haze conditions are such that traditional visual systems cannot be used. The system consists of a line scanner, combined with bispectral IR sensors, electronic target discriminator (TDM) and an in-flight image processor producing high quality imagery in near real time. During the 1970 fire season, one-third of a million square miles of terrain imagery was made on 41 operational patrol flights over an 8000-square-mile test area near the Montana-Idaho border selected for its high lightning fire occurrence. The TDM marked a total of 804 hot spots; 169 of these were wildfires; 44 were 'first discoveries' by the IR system. Only one verified false alarm was recorded. The system's fire mapping capability has also been demonstrated over several large forest fires. M.V.E.

A71-42157 Applications of infra-red techniques to fire protection. E. F. O'Sullivan and P. E. Burry. In: Joint Conference on Infra-Red Techniques, University of Reading, Reading, Berks., England, September 21-23, 1971, Proceedings. London, Institution of Electronic and Radio Engineers, 1971, p. 461-470. 14 refs.

Three applications of infra-red radiation sensors are discussed. Automatic fire detectors usually distinguish a fire from other sources of infra-red by sensing flicker of the flame. In situations where smoke complicates fire-fighting and rescue operations infra-red viewing and imaging devices are potentially useful because smoke becomes more transparent at longer wavelengths. To detect and map forest fires, airborne thermal imaging equipment is used. (Author)

A71-44987 * Crop surveys from multiband satellite photography using digital techniques. Paul E. Anuta and Robert B. MacDonald (Purdue University, Lafayette, Ind.). *Remote Sensing of Environment*, vol. 2, Oct. 1971, p. 53-67. 9 refs. U.S. Department of Agriculture Contract No. 12-14-100-10292(20); Grant No. NGR-15-005-112.

Analysis of multiband and multibase photography of the Imperial Valley, California, taken during the Apollo 9 mission using statistical multispectral pattern recognition techniques. With scanning microdensitometer, 70-mm frames were converted into digital form and stored on magnetic tape. All analysis was conducted using a digital computer which made possible rapid automatic processing of any of over five million film density measurements. Automatic recognition of fields of barley, sugar beets, and alfalfa was attempted, and the recognition accuracies were 75% for barley, 59% for sugar beets, and 27% for alfalfa. Highly accurate detection of bare soil, salt flats, and water was achieved. Low percentage ground cover crops such as lettuce, onions, carrots, and cabbage were indistinguishable from bare soil. Results using multiband photography are compared with results using color separations of color infrared photography which covered approximately the same bands.

(Author)

A72-10451 Manual and automatic-computerized systems of side-looking radar imagery analysis for crop discrimination. E. Y. Kedar and S.-Y. Hsu (New York, State University, Binghamton, N.Y.). In: American Society of Photogrammetry, Fall Convention, Symposium on Computational Photogrammetry, San Francisco, Calif., September 7-11, 1971, Proceedings. Falls Church, Va., American Society of Photogrammetry, 1971, p. 190-199.

The microtexture of side-looking radar imagery, composed of return and no-return signals of the radar, was investigated by both manual and automatic-computerized analytical systems of pattern recognition. The manual procedures included photographic enlargement, isodensitracer (IDT) scanning, and false color enlargement. Automatic and computerized procedures were involved with three-dimensional graphic display of the density surface obtained by IDT scanning, conversion of the density surface into numerical parameters, and automatic-computerized pattern recognition of crop types by means of multivariate discriminatory analysis.

T.M.

A72-10456 * Radar monitoring of agricultural land use - Some problems and potentials at the local level. F. M. Henderson (Center for Research, Inc., Lawrence, Kan.). In: American Society of Photogrammetry, Fall Convention, Symposium on Computational Photogrammetry, San Francisco, Calif., September 7-11, 1971, Proceedings. Falls Church, Va., American Society of Photogrammetry, 1971, p. 368-385. 6 refs. Contract No. NAS 9-10261. Task 2.5.

A study was made of some of the changing land use practices in a small area of the American Winter Wheat Belt as they might relate to remote sensing. In addition, interviews were conducted with farmers and local country agents in order to determine some of the needs regarding land use and farming practices as perceived by these people. A list of elements of land use is given which provides potential variables and parameters to be considered in interpreting radar imagery. The results of interviews provide a better concept of what potential remote sensing users at the primary level need and want.

T.M.

A72-10459 * Multiband photography - Forestry and agricultural applications. D. T. Lauer, A. S. Benson, and C. M. Hay (California, University, Berkeley, Calif.). In: American Society of Photogrammetry, Fall Convention, Symposium on Computational Photogrammetry, San Francisco, Calif., September 7-11, 1971, Proceedings. Falls Church, Va., American Society of Photogrammetry, 1971, p. 531-553. 17 refs. Contract No. NAS 9-9577.

The usefulness of multiband photography in forestry and agricultural applications was evaluated by a large group of skilled photo interpreters within four California test sites. Environmental parameters selected included crop types, forest vegetation types, and

tree species composition. Quantitative analyses were made of the interpretability of (1) multiband black and white photos viewed separately, (2) multiband black and white photos combined into true and false color composites, and (3) color and color infrared photos obtained simultaneously with the multiband black and white photography. Tests indicated that multiband photography consistently yielded higher interpretation accuracies than any types of single-band photography. Black and white multiband photos which were properly procured and displayed as false-color composite imagery in all cases rendered as much (or as little) information as conventional tri-emulsion color or infrared color film.

T.M.

A72-10951 Preliminary investigations on the root wilt disease in coconut plants in Kerala State /India/ by remote sensing technique /A NASA-ISRO-IARI-CCRS project/. C. Dakshinamurti, B. Krishnamurthy, A. S. Summanwar, P. Shanta, and P. R. Pisharoty. In: Astronautical research 1970; International Astronautical Federation, Congress, 21st, Konstanz, West Germany, October 4-10, 1970, Proceedings. Amsterdam, North-Holland Publishing Co., 1971, p. 850-854.

Review of some of the preliminary results, obtained through remote sensing techniques, on the root wilt disease in coconut plants in Kerala State. The techniques used included photography in several bands with black-and-white, color, and infrared Ektrachrome films. Samples collected for ground truth studies to correlate with infrared pictures are also discussed.

M.V.E.

A72-11789 # The reflectance spectra of mineralized trees. E. Yost and S. Wenderoth (Long Island University, Greenvale, N.Y.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 269-284. U.S. Geological Survey Contract No. 14-08-0001-12166.

Results of simultaneous in situ measurements of the quantity of solar radiation incident upon and reflected by a group of red spruce and balsam fir which grew upon and adjacent to a copper molybdenum anomaly. Two experiments suggest that soil mineralization directly affects the color of the tree needles. In both species the difference in reflectance is present in both the visible and near infrared spectral regions. Multispectral photographic camera filters would logically be chosen with peaks at 550 and 825 nm for the detection of anomalous red spruce trees.

F.R.L.

A72-11790 # Spectral reflectance properties of *Pinus ponderosa* in relation to copper content of the soil - Malachite mine, Jefferson County, Colorado. J. A. Howard, R. D. Watson, and T. D. Hessin (U.S. Geological Survey, Denver, Colo.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 285-297. 22 refs.

Measurements of the visible and near-infrared spectra of foliage taken from *Pinus ponderosa* growing in a copper-rich area are compared to the spectra of trees growing in a background area of low copper content. The degree of correlation between (1) soil and foliage-ash copper content and (2) copper content of foliage ash and spectral reflectance was tested. Results indicate that the highest correlation (0.51) between copper content of foliage ash and spectral reflectance occurs at a wavelength of 810 nm (nanometers). This correlation is established only in the field measurements and does not occur in the laboratory measurements. There are also differences in the reflected energy in the red and far-red regions of the visible spectrum (675-775 nm) that occur only in the field measurements. The differences between the laboratory and field results are attributed to possible needle-density differences.

(Author)

A72-11793 * # Remote sensing for detection of soil limitations in agricultural areas. C. J. Frazee, V. I. Myers, and F. C. Westin (South Dakota State University, Brookings, S. Dak.). In: Inter-

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national Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 327-343. 6 refs. NASA-supported research; USDA Contract No. 12-14-100-10291 /20/. NASA Order R-09-038-002.

Research was initiated to establish remote sensing techniques for recognizing and mapping soil limitations to land use. Analysis of soils with limitations to land use because of dense subsoil (claypan) and unfavorable topography (convex sloping or depressional areas) was accomplished by experienced soil scientists utilizing a density slicing system. Maps of soil limitations were produced by photographing the color encoded density slicing analysis of an area. The percentage of each soil limitation was measured by the planimeter feature of the density slicing system. The initial results indicate that a density slicing system has great potential not only for delineating areas of similar soil limitations but also for indicating the percentage composition of an area. (Author)

A72-11794 # Polarization of light scattered from moist soils. E. H. Stoghoff and R. T. Frost (GE Space Sciences Laboratory, Philadelphia, Pa.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 345-364. 10 refs.

Results of laboratory and field experiments concerned with quantitative recognition of the moisture content in the topmost layer of soil by means of the large enhancement in polarization of reflected visible sunlight as the moisture content is increased. Observations conducted with a number of soil types show that polarization measurement is one of the most sensitive methods for remote sensing of soil surface moisture. The technique is reasonably invariant to partial shadowing of rough surfaces being viewed or to their average inclination to the solar rays. Information on soil type will, however, be required for accurate reading of soil moisture over wide areas where various types are encountered. T.M.

A72-11798 # Remote sensing of tropical agricultural systems. V. R. Harnapp and C. G. Knight (Center for Research, Inc., Lawrence, Kan.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 409-433. 18 refs.

Development of inferential-analysis based model for the interpretation of remote-sensing observations designed to provide planners with information about agricultural systems. This model focuses on fundamental landscape phenomena (element, pattern, phase) which allow interpretation of particular agricultural systems within a broad agricultural typology. The model provides keys for interpretation, as well as a general analytical system for agricultural type discerning and mapping. Basic evaluation of the scale, resolution and timing of remotely sensed data for maximizing benefits from information gathered in rural development applications are discussed. Application of the model is illustrated by interpretations of aerial photography from two Puerto Rican sites taken in 1969. M.V.E.

A72-11814 * # Detection of southern corn leaf blight by remote sensing techniques. M. E. Bauer, P. H. Swain, R. P. Mroczynski, P. E. Anuta, and R. B. MacDonald (Purdue University, Lafayette, Ind.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 693-704. 5 refs. Grant No. NGL-15-005-112.

Multispectral photographic and scanner data were collected over western Indiana in August and September 1970, to determine the detectability of southern corn leaf blight by remote sensing. Measurements were made at altitudes of 3000 to 7000 ft. Color, color IR, and multiband black and white photography were collected

at altitudes from 3000 to 60,000 ft. Six levels of infection based on the amount of leaf damage were identified in the fields. Three levels of infection were detected with color IR photography by standard photo-interpretive techniques. Up to five levels of infection were distinguished by applying automatic pattern recognition techniques to the multispectral scanner data. The results illustrate the potential of remote sensing techniques in the detection of crop diseases. M.M.

A72-11815 # An ecological analysis of forest landscape parameters by multiband remote sensing. P. F. Krumpal, H. R. DeSelm, and C. C. Amundsen (Tennessee, University, Knoxville, Tenn.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 715-730. 26 refs. DOD-supported research. Project THEMIS.

A multiband remote sensing study was conducted to provide data for predicting distributional and statistical parameters of vegetation in areas devoid of ground control. Ground truth studies used one-fifth acre targeted plot areas and point samples in which Southern Appalachian landscape attributes were quantitatively measured, relatively scaled, or qualitatively classed. These included forest tree crown size, stand canopy closure, tree density and size, phenology, and other characteristics by species. Autumn- and winter-flown 70-mm imagery, obtained in different spectral bands at large and small photographic scales, was examined to assess the limits of this method in ground truth verification. A dichotomous key was prepared to aid in species identification and the separation of community types. Comparative studies of ground-truth and film-acquired data yielded predictive regression equations expressing their interaction. T.M.

A72-11835 # The use of small scale aerial photography in a regional agricultural survey. W. C. Draeger, L. R. Pettinger, and A. S. Benson (California, University, Berkeley, Calif.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 2. Ann Arbor, University of Michigan, 1971, p. 1205-1217.

The results of a semioperational agricultural inventory survey of limited Arizona areas using Apollo 9 photographs and some NASA regular 60,000 to 70,000 ft altitude mission multiband photographs are evaluated. The equipment used, the field data collected, the sampling techniques applied, and the data interpretation effectiveness achieved are discussed. It is concluded that a fully operational agricultural inventory using space photography is not beyond the capabilities of modern technology. V.Z.

A72-11854 # Possibilities for the use of sounding rockets in remote sensing programs. J. J. Tasso (Argentine Space Research Committee, Buenos Aires, Argentina). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 2. Ann Arbor, University of Michigan, 1971, p. 1519-1522. 18 refs.

Agricultural census and crop yield estimates are one of the main economic problems that may be solved through the use of remote sensing in Argentina. The utilization of satellite and aircraft data is being considered and programmed. The possibility of complementing them with sounding rockets has been raised and a preliminary report of possible advantages and limitations of this type of vehicle is presented. (Author)

A72-11856 * # Leaf light reflectance, transmittance, absorption, and optical and geometrical parameters for eleven plant genera with different leaf mesophyll arrangements. H. W. Gausman, W. A. Allen, C. L. Wiegand, D. E. Escobar, and R. R. Rodriguez (U.S.

Department of Agriculture, Soil and Water Conservation Research Div., Weslaco, Tex.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 1599-1625. 25 refs. NASA-supported research.

Review of research on radiation interactions within plant canopies and communities and interactions of various leaf structures (mesophyll arrangements) with electromagnetic radiation involved in the interpretation of data sensed from air or spacecraft. The hypothesis underlying the research reported is that leaf mesophyll arrangements influence spectral energy measurements of leaves.

M.V.E.

A72-11871 # On the feasibility of determining surface soil characteristics from remotely sensed microwave radiation. K. Ia. Kondrat'ev, Iu. M. Timofeev, and E. M. Shulgina (Glavnaia Geofizicheskaya Observatoriia, Leningrad, USSR). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 1917-1920. 5 refs.

A technique is proposed that makes possible an approximate determination of the depth-independent absorption coefficient and moisture content of soils and also the determination of the basic characteristics of the soil surface condition (i.e., moisture content and temperature-profile determining parameters). Based on remotely sensed microwave radiation, this technique takes advantage of the circumstance that, in the microwave region concerned, the atmosphere is practically transparent and the reflectance of the soil is low.

M.V.E.

A72-11881 * # Mapping soil types from multispectral scanner data. S. J. Kristof and A. L. Zachary (Purdue University, Lafayette, Ind.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 2095-2108. 9 refs. Grant No. NGL-15-005-112.

Multispectral remote sensing and computer-implemented pattern recognition techniques were used for automatic 'mapping' of soil types. This approach involves subjective selection of a set of reference samples from a gray-level display of spectral variations which was generated by a computer. Each resolution element is then classified using a maximum likelihood ratio. Output is a computer printout on which the researcher assigns a different symbol to each class. Four soil test areas in Indiana were experimentally examined using this approach, and partially successful results were obtained.

O.H.

A72-23279 # Use of aerial photographs for soil utilization mapping (Verwendung des Luftbildes in der Bodennutzungskartierung). I. Berényi (Magyar Tudományos Akadémia, Földrajztudományi Kutató Hírtérete, Budapest, Hungary). In: Internationale Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 1. Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 47-54. In German.

The advantages of aerial photography applied to the investigation of rural landscapes are outlined. It is shown that it can be used not only for determining the geographic, ecologic, and similar features of such studies but can be helpful also in the development of agricultural production. Specific fields of application are demonstrated by examples.

V.P.

A72-23280 # Complex landscape analysis with aerial photographs with respect to agricultural land use. Zs. Mike (Geodéziai és Kartográfiai Egyesület, Budapest, Hungary). In: Internationale

Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 1. Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 77-84.

Photo-interpretation methods are described, using which the main geomorphologic, geologic, and hydrographic features, inclinations, soil and vegetation, elements of microclimatic conditions, and the temporary land use can be studied simultaneously within the framework of the landscape. The differences in methods used in well developed and developing countries are pointed out.

V.P.

A72-23282 # Possibilities and limitations in the interpretation of false-color aerial photographs when taking state inventory of intensely cultivated wooded areas (Möglichkeiten und Grenzen der Interpretation falschfarbiger Luftphotos bei der Zustandsinventur intensiv bewirtschafteter Wälder). G. Wolff (Gesellschaft für Photogrammetrie in der Kammer der Technik, Berlin, East Germany). In: Internationale Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 1. Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 181-192. In German.

The status and trends of false-color photography applied to rationally planned and managed forestry are analyzed on the basis of results obtained during the past few years. The discussion is centered on the photographic techniques employed in this type of photography, the possibilities of obtaining additional information, the photo-interpretation methods, and the evaluation of the total information content of an aerial photograph.

V.P.

A72-23285 # Application of band color aerial photography to forest appraisal interpretations in the USSR (Die Anwendung der farbigen spektrozonalen Luftbildmessung für die forsttaxatorische Interpretation in der UdSSR). E. Demidov (Lesprojekt, Moscow, USSR). In: Internationale Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 1. Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 243-255. In German.

The principles and possibilities of multiband color aerial photography as a means of surveying and evaluating large forested areas are outlined. The advantages and drawbacks of the individual techniques and instruments employed are reviewed.

V.P.

A72-23286 # Photointerpretation of the forest test territory of Rábagyarmat on the basis of color aerial photographs (Photointerpretation des forstlichen Testgebietes von Rábagyarmat aus farbigen Luftbildaufnahmen). I. Doklea, F. Németh (MEM Allami Erdrendezőszékek Muszaki Irodája, Budapest, Hungary), and A. Rada (Research Institute for Water Resources, Budapest, Hungary). In: Internationale Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 1. Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 257-266. In German.

Aerial photography is used for the determination of forest composition with respect to the various types of trees involved. There are certain problems with the information content of the black-and-white films presently used because of limitations of the shades of gray. Tests were, therefore, conducted with IR-sensitive black-and-white films and color films. It was found that the recognition of various types of trees is easier with color film than with black-and-white films. However, this advantage does not compensate for the higher costs involved in the use of color films.

G.R.

A72-23287 # The determination of vegetal cover using multiband aerial photography. W. J. Gittins (Melbourne, University, Melbourne, Australia). In: Internationale Gesellschaft für Photogram-

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metrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 1. Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 267-280. 14 refs. Research supported by the Forests Commission of Victoria, Soil Conservation Authority of Victoria, and Commonwealth Rural Credits Fund.

Description of attempts to develop the use of air-photo interpretation for the accurate estimation of cover. The aims are to compare the accuracy of multiband photographic methods for measuring cover with field methods, and to evaluate the most suitable film types, seasons, and scales of photography. Results from normal color film were closest to those obtained by field sampling. The most suitable season was found to be late spring and summer in closed forest. In open forest, autumn proved more satisfactory.

F.R.L.

A72-23288 # Multi-band concepts of forested land-units. J. A. Howard (Melbourne, University, Melbourne, Australia). In: Internationale Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 1. Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 281-316. 41 refs.

Review of hierarchic classifications of land-units which have been developed using black-and-white photographs, followed by consideration of the influence of the widening choice of film-filter combinations on hierarchic classification. 'Land-unit' is used as a general term, which is applicable to a classificatory landscape unit of any magnitude. Land-units identifiable on aerial photographs and multiband photointerpretation are discussed, and examples are given.

F.R.L.

A72-23289 # Evaluation of color aerial photographs for the demarkation of damage to forests (Auswertung von Farbluftbildern für die Abgrenzung von Schädigungen an Waldbeständen). H. Kenneweg (Freiburg, Universität, Freiburg im Breisgau, West Germany). In: Internationale Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 1.

Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 331-337. 12 refs. In German.

Aerial photographs with four film-filter combinations were obtained of a forest area in which fumes from a brickkiln had caused grave damage to the forest. It was found that damage in conifer stands can be most easily detected and classified on 1:5000 false color aerial photos taken in early July. Injured trees could be more rapidly recognized with the aid of ordinary color film. However, false color film was judged to be superior to ordinary color film with regard to the recognition of killed trees.

G.R.

A72-23290 # Employment of false color aerial photographs for the determination of the road quality classification in forests (Verwendung von falschfarbigen Luftbildern bei der Bestimmung der Befahrbarkeitsklasse von Waldwegen). G. Klier (Gesellschaft für Photogrammetrie in der Kammer der Technik, Berlin, East Germany). In: Internationale Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 1.

Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 339-343. In German.

Roads in forests in the German Democratic Republic are classified in four categories according to the condition of the road. The false color photography makes use of the fact that most objects show different reflection characteristics for light of the various spectral ranges. It was found that forest roads in false color photographs show a great variation with regard to their color. A road

classification from aerial false color photographs was possible in 70 per cent of all cases. In the remaining cases the roads had been hidden by the adjacent forest growth.

G.R.

A72-23291 # Principles of a modern aerial photo interpretation in the forest administration of the German Democratic Republic (Grundsätze einer modernen Luftbildinterpretation in der Forsteinrichtung der Deutschen Demokratischen Republik). H. Kreibitz (Gesellschaft für Photogrammetrie in der Kammer der Technik, Berlin, East Germany). In: Internationale Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 1. Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 355-361. In German.

The administrative branch considered is concerned with the periodic analysis of forest conditions, the regulation of the natural reproduction, and the control of any changes regarding the forests. Data are also to be provided to central administrative agencies of the state economy for the optimal control and regulation of forest development. The introduction of electronic data processing methods was found to be a great aid for the forest administration. The advantages of aerial photography in providing the necessary information is discussed.

G.R.

A72-23313 # Interpretation of some pedological factors from aerial photographs, in relation to different seasons and different emulsions (Interprétation de quelques facteurs pédologiques, à partir de photographies aériennes, en relation avec différents saisons et différentes émulsions). M. C. Girard (Ecole Nationale Supérieure Agronomique, Yvelines, France). In: Internationale Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 2. Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 925-947. In French.

Attempt to determine the relations which exist between the image of the ground which is given by a photograph, and the ground elements which are the causes of the observed image. The photographed colors cannot be used directly, since their variation allows only an interpretation. The times favorable for taking photographs of interest to the soil scientist are very short, and are more related to the agricultural calendar than to the seasons. Photographs should be made on two scales, one to determine the landscape, and the other to catch detail. Panchromatic and false-color emulsions should be used.

F.R.L.

A72-26985 Nonsupervised crop classification through airborne multispectral observations. G. Nagy and J. Tolaba (IBM Thomas J. Watson Research Center, Yorktown Heights, N.Y.). *IBM Journal of Research and Development*, vol. 16, Mar. 1972, p. 138-153. 46 refs.

Current methods of terrain classification by means of airborne multispectral observations are reviewed with emphasis on the selection of training sets for determination of the categorizer parameters. A method of selecting sample regions for assigning identities to the spectral signatures on the basis of statistically determined similarities, rather than on a priori considerations, is suggested. We have found that a simple clustering algorithm, modified to take into account specific features of the crop-census problem, can be used to obtain the desired homogeneous regions with relatively little computation and that very sparse sampling of these regions is sufficient to assign the appropriate category to each cluster. Viewed as a two-stage sampling procedure, clustering improves the second stage classification on 15 crops from 20 to 50 percent over a random selection of the primary sampling units. The accuracy increases to 73 percent when only five classes are considered, with further improvement to 88 percent when a majority decision based on known field boundaries is used.

(Author)

A72-31249 # Development of a computer controlled ground truth station to complement the application of remote sensing in agriculture. E. J. Brach and A. R. Mack (Department of Agriculture, Research Branch, Ottawa, Canada). In: Space activity in the field of ecology and earth resources; International Convention on Space, 12th, Rome, Italy, March 23-25, 1972, Proceedings.

Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1972, p. 391, 393-403. 17 refs.

A system to collect and measure spectral and environmental data of agricultural crops to measure yield, disease, and to serve as a ground truth station for flying platform measurements is discussed. The design and performance of each system component, the interfacing of the computer, print-out format, and the flowchart of the computer program is presented. O.H.

A72-31250 # Considerations in detecting and managing forest fires from a space platform. C. C. Chandler (U.S. Forest Service, Washington, D.C.). In: Space activity in the field of ecology and earth resources; International Convention on Space, 12th, Rome, Italy, March 23-25, 1972, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1972, p. 405, 407-412.

The considerations that effected integration of aerial infrared line scanners into the forest fire control operations of the U.S. Forest Service are reviewed. Systems rather than instruments are dealt with. The considerations involved in escalating an infrared detection system from aircraft to spacecraft are also discussed. O.H.

A72-31396 # Remote vegetation productivity sensing in the visible spectrum band (Distsionnaya indikatsiya produktivnosti rastitel'nosti v vidimoi zone spektra). B. V. Vinogradov. *Problemy Fiziki Atmosfery*, no. 9, 1971, p. 77-87. 30 refs. In Russian.

The application of photometry and spectrometry in the visible band for vegetation surveys is discussed on the basis of experiences in deserts and semideserts of Kazakhstan. The uses of the spectral brightness coefficient and photodensity measurements in vegetation productivity sensing are covered. V.Z.

A72-36318 Prediction of site and cover parameters. H. R. DeSelm, C. C. Amundsen, and P. F. Krumpe (Tennessee, University, Knoxville, Tenn.). In: Scanning the spectrum; Proceedings of the Tenth Annual Region 3 Convention, Knoxville, Tenn., April 10-12, 1972. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. M3-1 to M3-4. 27 refs. DOD-supported research. Project THEMIS.

Large to intermediate scale ektachrome color and ektachrome color infra-red film imagery has been used to assess little managed landscape characteristics. Detailed ground control information of both qualitative and quantitative types in specified areas (plots) is required. Amenable to this study are tree species and vegetation cover type determination, tree bole density (all trees per acre and trees per species per acre), crown closure, tree bole diameter class, leaf litter area, fallen log and boulder number per acre, slope angle and minor topographic form. Site information alone can, by correlation, add significant vegetation details not always visible from photography. (Author)

A72-36320 Multispectral photography in soil moisture determination and soil series differentiation. J. I. Sewell and W. L. Parks (Tennessee, University, Knoxville, Tenn.). In: Scanning the spectrum; Proceedings of the Tenth Annual Region 3 Convention, Knoxville, Tenn., April 10-12, 1972. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. M5-1 to M5-4. 10 refs.

A73-13844 The use of stress situations in vegetation for detecting ground conditions on aerial photographs. H. Svensson, (Lund, Universitet, Lund, Sweden). *Photogrammetria*, vol. 28, Sept. 1972, p. 75-87. 7 refs.

A73-15402 * Data handling and analysis for the 1971 corn blight watch experiment. P. E. Anuta, T. L. Phillips, and D. A. Landgrebe (Purdue University, Lafayette, Ind.). In: NTC '72; National Telecommunications Conference, Houston, Tex., December 4-6, 1972, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 14A-1 to 14A-8. 5 refs. Grant No. NGL-15-005-112.

Review of the data handling and analysis methods used in the near-operational test of remote sensing systems provided by the 1971 corn blight watch experiment. The general data analysis techniques and, particularly, the statistical multispectral pattern recognition methods for automatic computer analysis of aircraft scanner data are described. Some of the results obtained are examined, and the implications of the experiment for future data communication requirements of earth resource survey systems are discussed. M.V.E.

A73-15782 Remote sensing of the near-surface moisture profile of specular soils with multi-frequency microwave radiometry. G. Poe (Aerojet-General Corp., El Monte, Calif.). In: Remote sensing of earth resources and the environment; Proceedings of the Seminar-in-Depth, Palo Alto, Calif., November 8, 9, 1971. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1972, p. 135-145. 12 refs. Contract No. NOAA-0-35239.

A73-16745 Remote sensing for healthier crops. H. D. Wolpert (TRW, Inc., Cleveland, Ohio). *Optical Spectra*, vol. 6, Dec. 1972, p. 21-25.

The application of remote sensing to problems associated with agricultural crops which are diseased or stressed in various ways is discussed. An electrooptical device is described which makes possible early detection of disease, remote detection from a light aircraft, expanded detection range and scope, flexibility and mobility allowing repeated overflights to check on the progress of corrective action, and real time display. F.R.L.

A73-17128 * Effects of leaf age for four growth stages of cotton and corn plants on leaf reflectance, structure, thickness, water and chlorophyll concentrations and selection of wavelengths for crop discrimination. H. W. Gausman, W. A. Allen, R. Cardenas, and A. J. Richardson (U.S. Department of Agriculture, Soil and Water Conservation Research Div., Weslaco, Tex.). In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 25-51. 27 refs. NASA-supported research. NASA Order R-09-038-002.

A73-17134 The potential application of space technology to the radio tracking and biotelemetry of unrestrained animals. R. F. Pascucci, N. A. Liskov, and L. E. Garvin (Raytheon Co., Equipment Div., Wayland, Mass.). In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 219-247.

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A73-17142 * A comparison of two approaches for category identification and classification analysis from an agricultural scene. J. A. Schell (Texas A & M University, College Station, Tex.). In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March, 13, 14, 1972. Volume 1.

Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 374-394. 12 refs. Grant No. NSG-239-62.

Supervised and unsupervised classification modes are discussed in light of the multidisciplinary, high data rate requirements of the ERTS satellites soon to be launched. Inadequacies of each system in light of these requirements are noted and a compromise solution to the data classification system is proposed. An example of results obtained with an implementation of this system are shown and compared with results from a supervised classification scheme.

(Author)

A73-18437 Measurements regarding the color of aerial photographs in studies of the vegetation (Farbmessungen an Luftbildern für vegetationskundliche Zwecke). W. Tzschupke (Freiburg, Universität, Freiburg im Breisgau, West Germany). *Bildmessung und Luftbildwesen*, vol. 41, Jan. 1, 1973, p. 12-20. 25 refs. In German.

Drawbacks of conventional visual aerial photograph evaluation are discussed, giving attention to limitations of the human capability concerning the recognition of very small color differences and to the time needed for an evaluation by human experts. There are three approaches available for the measurement of color. The approach which is important for the vegetation studies makes use of three photoelectric devices for the determination of the brightness in the three basic spectral ranges. The method involved corresponds to the principles of operation of a color densitometer. Such an instrument was, therefore, used in an investigation of damage produced in a spruce forest. It was possible to differentiate four damage classes on a false color picture.

G.R.

A73-33355 * Physiological factors and optical parameters as bases of vegetation discrimination and stress analysis. C. L. Wiegand, H. W. Gausman, and W. A. Allen (U.S. Department of Agriculture, Rio Grande Soil and Water Research Center, Weslaco, Tex.). In: Operational remote sensing; Proceedings of the Seminar, Houston, Tex., February 1-4, 1972. Falls Church, Va., American Society of Photogrammetry, 1972, p. 82-100; Discussion, p. 101, 102. 65 refs. NASA-supported research. NASA Order R-09-038-002.

The successful application of photographic, optical-mechanical scanning, and other sensing techniques to vegetation must be based on an understanding of the biological and physical principles involved. The objective is to review the biological and optical characteristics of vegetation and to discuss how knowledge of them can support operational programs by aiding in wavelength selection, timing of missions, and discriminations between vegetation types as well as between healthy and stressed plants of the same type. Both laboratory situations, in which relatively pure spectral data are obtained, and field situations are considered. In the latter, sensor performance and background variables affect data quality.

F.R.L.

A73-34848 # Realizations and programs of application of remote sensing in agriculture (Realizzazioni e programmi di applicazione del remote sensing in agricoltura). E. Rosini, O. Serrica, and D. Vento (Ministero dell'Agricoltura e delle Foreste, Rome, Italy). In: The control of the terrestrial environment from space: International collaboration, methods and technologies; International Conference on Space, 13th, Rome, Italy, March 22-24, 1973, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1973, p. 295, 297-305. 7 refs. In Italian.

Review of the possible applications of remote sensing in the practice and development of agriculture. A few brief considerations of general nature are presented, including a definition of remote sensing and some remarks concerning the sensors and aerospace platforms required, the necessary ground-based supporting observations, and economic factors. After this, the applications of remote sensing in agriculture and forestry are reviewed, including uses in land inventories, soil classification, production forecasts, the control of natural or man-made calamities, and the detection and utilization of water resources. Finally, the applicability of remote sensing to the particular situation in Italy is illustrated in the case of hail control and viticulture.

A.B.K.

A73-36023 * # ERTS-1 MSS imagery - A tool for identifying soil associations. F. C. Westin (South Dakota State University, Brookings, S. Dak.). *COSPAR, Plenary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper*. 26 p. 6 refs. Contract No. NAS5-21774.

Soil association maps show the spatial relationships of land units developed in unique climatic, geologic, and topographic environments, and having characteristic slopes, soil depths, textures, available water capacities, permeabilities, and the like. From these characteristics of the soil, broad interpretations can be made such as how the soil is suited for various agronomic and engineering uses. ERTS-1 imagery was found to be a useful tool in the identification of soil associations since it provides a synoptic view of an 8 million acre scene, which is large enough so that the effect can be seen on soils of climate, topography, and geology. A regional view also allows soil associations to be observed over most, if not all, of their extent. This aids in selecting typical sampling sites and provides a check on the homogeneity of the associations.

(Author)

A73-39836 * # Results of the 1971 Corn Blight Watch experiment. R. B. MacDonald (NASA, Washington, D.C.), M. E. Bauer, D. A. Landgrebe (Purdue University, Lafayette, Ind.), R. D. Allen, J. W. Clifton (U.S. Department of Agriculture, Washington, D.C.), and J. D. Erickson (Michigan, University, Ann Arbor, Mich.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1.

Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 157-189.

The objective of the experiment was to evaluate the use of advanced remote sensing techniques to detect the development and spread of southern corn leaf blight during the growing season across the Corn Belt region. The sampling plan involved the selection of the study area, the determination of the flightline, and the determination of a field sample design. Aspects of data acquisition are discussed, giving attention to ground data collection and aerial data collection. Details of data flow are considered along with data analysis procedures and corn blight records. The experiment results are examined, taking into account photointerpretation results, the machine analysis of multispectral scanner data results, the influence of blight on yields, and questions of crop identification.

G.R.

A73-39849 # Land use classification in the southeastern forest region by multispectral scanning and computerized mapping. F. P. Weber, R. C. Aldrich (U.S. Forest Service, Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.), F. G. Sadowski, and F. J. Thomson (Michigan, Environmental Research Institute, Ann Arbor, Mich.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1.

Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 351-373. 14 refs.

The feasibility of mapping land use categories by airborne multispectral scanning was tested over two 42-square-kilometer sites in the Southeastern United States. New techniques were applied in

preprocessing the data collected to compensate for effects of atmosphere and changing solar irradiance. The capabilities of extending spectral signatures from one training flight line to three additional lines for both test sites were analyzed. The data processed by the spectral analysis recognition computer system were compared to those obtained from color infrared photographs and ground surveys. The effects of time-of-day and selection of optimum channel on accuracy of mapping classification were investigated. (Author)

A73-39871 # Progress report on aircraft gamma-ray surveys for soil-moisture detection at a NOAA test site near Phoenix, Arizona. D. R. Wiesnet (NOAA, National Environmental Satellite Service, Washington, D.C.) and E. L. Peck (NOAA, National Weather Service, Silver Spring, Md.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 747-754. 9 refs.

A73-39873 # Automatic terrain mapping by texture recognition. E. E. Triendi (Institut für Satellitenelektronik, Oberpfaffenhofen, West Germany). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 771-778.

Black and white air photos of forest areas are processed into maps by the recognition of forest textures. Only two features are used: the moving average of the grey value and its second derivative. Borderline behavior, a more general approach and the connections to multispectral image recognition are discussed. (Author)

A73-39877 # Adaptive multispectral recognition of agricultural crops. F. J. Kriegl, R. E. Marshall, H. Horwitz, and M. Gordon (Michigan, Environmental Research Institute, Ann Arbor, Mich.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 833-849. 7 refs.

The use of adaptation offers an improvement in performance in a maximum-likelihood classifier for recognition of objects in a scene as observed by a multispectral scanner. Some sources of error in classification are presented, and those correctable by adaptation are discussed. Some experiments are described which, for the case of adaptive recognition of agricultural crops, indicate the kinds of improvements which may be expected from such a classifier. The performance of the classifier is discussed, and a more general framework is presented which uses scene information and modeling to improve adaptation. (Author)

A73-39900 * # Temporal analysis of multispectral scanner data. A. J. Richardson, C. L. Wiegand, and R. J. Torline (U.S. Department of Agriculture, Weslaco, Tex.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 1249-1258. 7 refs. NASA-supported research. NASA Order R-09-038-002.

Multispectral scanner reflectance data were sampled for bare soil, cotton, sorghum, corn, and citrus at four dates during a growing season (April, May, June, and July 1969) to develop a time-dependent signature for crop and soil discrimination. Discrimination tests were conducted for single-date and multirate formats using training and test data sets. For classifications containing several

crops, the multirate or temporal approach improved discrimination compared with the single-date approach. The multirate approach also preserved recognition accuracy better in going from training fields to test fields than the single-date analysis. The spectral distinctiveness of bare soil versus vegetation resulted in essentially equal discrimination using single-date versus multirate data for those two categories. (Author)

A73-39901 * # Multispectral scanner imagery for plant community classification. R. S. Driscoll (U.S. Department of Agriculture, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.) and M. M. Spencer (Michigan, Environmental Research Institute, Ann Arbor, Mich.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 1259-1278. NASA-supported research. NASA Order R-09-038-002; NASA Order R-9-9784.

Optimum channel selection among 12 channels of multispectral scanner imagery identified six as providing the best information for computerized classification of 11 plant communities and two nonvegetation classes. Intensive preprocessing of the spectral data was required to eliminate bidirectional reflectance effects of the spectral imagery caused by scanner view angle and varying geometry of the plant canopy. Generalized plant community types - forest, grassland, and hydrophytic systems - were acceptably classified based on ecological analysis. Serious, but soluble, errors occurred with attempts to classify specific community types within the grassland system. However, special clustering analyses provided for improved classification of specific grassland communities. (Author)

A73-39902 # On microwave remote sensing of vegetation. F. T. Ulaby, R. K. Moore, R. Moe, and J. Holtzman (Center for Research, Inc., Lawrence, Kan.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 1279-1285. 5 refs.

Spectral response data were obtained from agricultural targets covering 83 fields with 4 crop types - corn, sorghum, soybeans, and alfalfa. An octave-bandwidth radar mounted atop a 40-ft truck-mounted boom was used to measure the return at ten frequency points across the 4- to 8-GHz band at six different look angles and for both horizontal and vertical polarizations. The information content inherent in bandwidth, polarization, and look angle was investigated by applying crop type classification techniques. The results indicate that, for the four category cases, the probability of correct identification (based on single-frequency and single-polarization data) can be improved by a factor of 2, if an octave frequency bandwidth and dual polarizations are used. (Author)

A73-39904 # Detection of small fires and mapping of large forest fires by infrared imagery. K. Ia. Kondrat'ev, L. N. D'iachenko, V. I. Binenko, and A. P. Chernenko (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 1297-1310. 8 refs.

The possibilities of using infrared scanning radiometers for the detection of incipient forest fires from aircraft have been investigated. Concrete data on the optimal altitudes for patrol aircraft have been obtained for detecting very small fires with areas of 0.3 x 1.0 and 0.5 x 0.5 sq m. The use of infrared radiometers makes it possible to map large forest fires obscured by dense smoke. It also makes it possible to determine the location, configuration, and intensity of burning of the edge of a fire, as well as the speed and direction of its movement. Technical recommendations are made regarding the

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performance parameters of an IR detection system intended for installation on forest patrol aircraft. (Author)

A73-39906 # Photodensity and the impact of shifting agriculture on subtropical vegetation - A case study in the Bahamas. R. Byrne and J. C. Munday, Jr. (Toronto, University, Toronto, Canada). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 1311-1326. 12 refs.

Photographic densities of areas subjected to shifting agriculture on Cat Island, Bahamas, have been compared with ground truth cover data. With increasing photodensity, pioneer species decrease in areal cover, shade-tolerant species increase, the number of species decreases, and average height of the vegetation increases. The prediction accuracy for presence of dominant species is high. The relative prediction error for areal cover of individual species is large, and twice as great for rare as for dominant species. Thus, photodensity can monitor recovery of floristically complicated subtropical vegetation following clearing, burning, and cultivation, and photodensity indicates with some success the floristic composition. The results imply that carrying capacity can be determined from photodensity. (Author)

A73-39908 # Plant canopy models for simulating composite scene spectroradiance in the 0.4 to 1.05 micrometer region. J. A. Smith and R. E. Oliver (Colorado State University, Fort Collins, Colo.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 1333-1353. 9 refs. Grant No. DA-ARO(D)-31-124-71-G165.

A Monte Carlo Model has been developed for simulating the interaction of direct and diffuse shortwave radiation with the canopy of shortgrass prairie vegetation (*Bouteloua gracilis*). The model treats the canopy as consisting of layered statistical ensembles of foliage elements against a soil background. A two-layer canopy containing only one constituent and a soil background is simulated. Geometric characteristics of the foliage, optical properties of the leaves and soil, and spectroradiance determinations were obtained during the 1972 summer field season. The model correctly accounted for the apparent directional reflectance of the canopy as seen by a vertical view sensor for all wavelengths between 0.4 and 1.05 micrometers, except at the chlorophyll absorption region between 0.65 and 0.70 micrometers. The single constituent model was not able to account for the apparent directional reflectance for the canopy for a sensor inclined at 40 degrees from the zenith. It is hypothesized that the model would need to be run with a second constituent, also present in the canopy, to account for this disagreement. (Author)

A73-39907 # Remote mapping of standing crop biomass for estimation of the productivity of the shortgrass prairie, Pawnee National Grasslands, Colorado. R. L. Pearson and L. D. Miller (Colorado State University, Fort Collins, Colo.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 1355-1379. 16 refs.

The U.S. IBP Grassland Biome Program sponsored by the National Science Foundation has undertaken an ecosystem analysis study of an entire shortgrass prairie biome using systems analysis techniques. One of the most important spatial parameters of the grassland biome which must be determined on an areal basis is the amount of vegetation present on the prairie at a particular place and time. Estimates of the amount of vegetation present have traditionally been made by hand clipping plots of known area with shears and weighing the dried vegetation from the plot trimmed to determine the mass of vegetative material per unit area, its biomass, and its calorie equivalent. A more efficient means of determining the amount of plant cover has been devised using remote spectral

measurements of the vegetation. These measurements can be obtained from any altitude allowing small plot estimates from ground measurements or large area estimates from aerial or satellite measurements. (Author)

A73-39911 # The usefulness of ERTS-1 and supporting aircraft data for monitoring plant development in rangeland environments. D. M. Carnegie and S. D. DeGloria (California, University, Berkeley, Calif.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 1471-1476.

A73-41334 # Multi-stage acquisition of forest information from space and aircraft imagery and ground sampling. K. Kuusela and S. Poso (Forest Research Institute, Helsinki, Finland). In: Space research XIII; Proceedings of the Fifteenth Plenary Meeting, Madrid, Spain, May 10-24, 1972. Volume 1. Berlin, East Germany, Akademie-Verlag GmbH, 1973, p. 113-117.

Pictures taken by the meteorological satellite *Essa 8* on Mar. 21, 1969, from an altitude of 1500 km and on a scale of 1:13 million were used in an experiment covering 17 million hectares. A highly significant regression was found between the darkness grades on the picture and the mean volume of the forest growing stock per area unit for the aggregate of land and inland waters. In a second experiment, a systematic sample of photointerpretation plots was located on aircraft pictures taken from an altitude of 9.5 km at 1:60000 over an area of 2.8 million hectares. The photo plots were combined into groups which were homogeneous with regard to the interpreted forest characteristics. A random plot from each group was selected and measured in the field. Photo plots were furnished with data from the ground plot in each particular group and final forest-resource estimates were calculated for areas formed from any set of photo plots. (Author)

A73-43779 # Use of earth resources satellites for supranational inventories of forests and agricultural areas (Zum Einsatz von Erdkundungssatelliten für supranationale Inventuren der Wälder und landwirtschaftlichen Nutzflächen). G. Hildebrandt (Freiburg, Universität, Freiburg im Breisgau, West Germany). *Raumfahrtforschung*, vol. 17, July-Aug. 1973, p. 164-168. 9 refs. In German.

Considerations about the use of satellites for inventory and control of natural resources and human environment have to start with the questions: which information and what reliability are necessary and which information may be available by remote sensing from satellites. The necessary information, together with the spectral properties of remote objects, requires multispectral techniques and high ground resolution, as well as a concept which allows the inventory of very large areas in various seasons of the year and - as a sample - the collection of detailed information. Therefore, it is suggested to develop a multistage inventory system with remote sensing from several platforms and with several sensors. (Author)

N70-16762# Purdue Univ., Lafayette, Ind., Lab. for Agricultural Remote Sensing.

AGRICULTURAL APPLICATIONS AND REQUIREMENTS PROGRAMS Quarterly Progress Report 1 Jan. - 31 Mar. 1969 31 Mar. 1969 38 p (QPR-2) Avail: CPSTI

Agricultural applications and requirements for remote sensing of environmental resources are summarized. A proposal is discussed for a prototype data system to provide information and consultation to farmers, governmental agencies, and agribusiness. Research, pilot utilization, and educational programs are reviewed. Goals are

to take present data acquisition and processing technology by remote sensing to a point adequate to accept planned earth resources satellite data, and to provide for a pilot data distribution and user educational system. Biophysical research, physical measurements, and data processing program work is reviewed. Remote sensing technology applications are described for: (1) pattern recognition programs for nonagricultural wildland resources, (2) crops classification mapping, and (3) flight analysis of crop areas C-3 and C-4.
J.A.M.

N70-17617* Agricultural Research Service, Weslaco, Tex.
SPECTRAL SURVEY OF IRRIGATED REGION CROPS AND SOILS Annual Report, 1 Oct. 1968-30 Sep. 1969

30 Sep. 1969 450 p refs

(NASA Order R-09-038-002)

(NASA-CR-107881) Avail: CFSTI CSCL08G

Research reports on remote sensing investigations are presented. Applications include color recombinations imagery for soils and plants; reflectance of single leaves and plots of cotton, and detection of cellular discoloration in cotton; and the detection of insect damage and foot rot disease of citrus trees with infrared film. Reflectance produced by vegetation on a soil background was studied by isotropic light interacting with a compact plant leaf, plant irradiance specified by Duntley equations, and incident and reflected short wavelength radiation. The relationship between near infrared reflectance and cotton maturity is described. Aerial film types, photointerpretation, and mapper imagery are also discussed. Details are given on the discrimination of vegetation by multispectral reflectance, the discrimination on infrared film of crop species and soil conditions, and 9-channel scanner data. The procurement of a field spectrometer and random errors associated with a spectrophotometer are mentioned. Trips to Brazil and Mexico by the agriculture representative to NASA's International Participation Program are also reported.
N.E.N.

N70-24620* Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
A PROGRAM TO ACQUIRE ENVIRONMENTAL FIELD DATA IN FOUR AREAS IN A HUMID SUBTROPIC ENVIRONMENT Final Report, 1 May 1968-31 Aug. 1969

John E. Walker Nov. 1969 168 p refs

(Contract F19628-68-C0339)

(AD-698345; CAL-VT-2636-O-1; AFCRL-69-0393) Avail: CFSTI CSCL 8/6

Multiband remote sensing provides a means of obtaining signatures for natural earth objects and backgrounds. Data were collected from four humid tropical environments in Puerto Rico. Irradiance spectral reflectance, surface temperature, soil moisture, soil granularity, air temperature, humidity, wind speed and direction measurements and ground photographs were obtained. The limited analysis resulted in the development of bi band methodology for determining whether variations in film image density of soil is caused by surface moisture or surface structure. It is concluded that an electro-optical multiband analysis system using bi band techniques can be developed to facilitate the task of terrain analysis and at the same time provide the tools necessary to extend the utility of multiband remote sensing to obtain spectral signatures for other earth objects and backgrounds.
TAB

N70-26803* Army Engineer Topographic Labs., Fort Belvoir, Va.

USE OF SIDE-LOOKING AIRBORNE RADAR (SLAR) IMAGERY FOR ENGINEERING SOILS STUDIES

David J. Barr Sep. 1969 133 p refs

(AD-701902; USAETL-46-TR) Avail: CFSTI CSCL 17/9

The report is concerned with the development and evaluation

of techniques of utilizing Side-Looking Airborne Radar (SLAR) imagery for engineering soils studies. The primary objective was the development of a systematic SLAR image interpretation technique. Secondary objectives included an evaluation of methods for quantification of SLAR image textures and radar shadows. SLAR images from a variety of physiographic regions within the United States were evaluated. Systems operating at several wavelengths were represented in the study. Field checking was performed for several of the study sites.
Author (TAB)

N70-27501* Army Tropic Test Center, Fort Clayton (Canal Zone).
ENVIRONMENTAL DATA BASE FOR REGIONAL STUDIES IN THE HUMID TROPICS Semiannual Report, 1 Mar. 1968-28 Feb. 1969

Edward E. Garrett, ed. Oct. 1969 91 p refs

(ARPA Order 740)

(AD-701109; USATTC-6909003; SA-6; SA-7) Avail: CFSTI CSCL 4/2

The report summarizes the activities of the Environmental Data Base Project for the period March 1968 through 1969 and contains a brief statement on project background, scope, and observation sites, together with some analyses of the collected data. The Climate Section contains an operational description of the automatic data and recording system, a detailed analysis of the climatological and measurement aspects of evaporation. The Soils and Hydrology Section presents the profile descriptions of the soils at the Fort Kobbe Satellite Sites. The Vegetation Section contains an analysis of litter fall at the Albrook Forest Site. The section of Atmospheric Chemistry consists of a brief summarization of activities in this field for the reporting period. The section on Macrofauna contains a tabulated listing of insects secured under the black-light sampling program.
Author (TAB)

N70-27584* Department of Agriculture, Washington, D.C.
Research and Development Branch.

RELATIONSHIP OF FILM OPTICAL DENSITY TO YIELD INDICATORS

Donald H. Von Steen, Ross W. Leamer, and Alvin H. Gerbermann [1969] 18 p

(NASA Order W-12996)

(NASA-CR-109836) Avail: CFSTI CSCL 14E

Statistically significant relationships were found between certain preharvest yield indicators and film densities of aerial infrared film in micro experiments. These studies suggest a fixed relationship may exist for important yield components which makes it possible to estimate crop yields with remote sensing techniques. Cotton, grain sorghum, carrots, cabbage, and onions were included in the study. Ground data from small plots improve the estimates made from film density measurements.
Author

N70-31335* Air Force Cambridge Research Labs., Bedford, Mass.
EARTH SCIENCE APPLIED TO MILITARY USE OF NATURAL TERRAIN

Stanley M. Needleman and C. E. Molineux Aug. 1969 212 p refs *Its AF Surv. in Geophys. No. 211*

(AD-704140; AFCRL-69-0364) Avail: CFSTI CSCL 8/2

A survey of the state-of-the-art in the evaluation of natural terrain by earth-science techniques and measurement systems is presented in response to a need that existed for many years. This report considers the terrain as an envelope of the environment and all related parameters that are basic in an evaluation for relevant military applications such as unimproved landing areas, trafficability, site selection for operational facilities, terrain reconnaissance and

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surveillance, and target detection within a masked terrain complex. Methods of terrain-data acquisition, analysis, and evaluation and their limitations are reviewed. The status of research and development, specifying the gaps in technology, is summarized with accompanying conclusions. The report forecasts the requirement for an automated terrain-data acquisition, storage, and display system. Information pertaining to the classification of terrain data, field devices to measure bearing strength, and a visualized optimum remote sensing system is also given in the appendix. A glossary and a comprehensive bibliography are included. Author (TAB)

N70-33791*# Michigan Univ., Ann Arbor, Willow Run Labs.
RADAR DATA COLLECTION MISSION, ADDENDUM Final Report

R. A. Rendleman Jun. 1970 13 p
(Contract NAS9-10211)
(NASA-CR-108500; WRL-3261-1-F1-Add) Avail: CFSTI CSCL 171

Some of the useful information available in radar images is demonstrated. Observations on data gathered at Lawrence, Kansas with and without ground truth are presented. It is concluded that changes of intensity and texture of fields, when observed repeatedly, can contribute to a history of field operations which would be significant in understanding the agricultural situation. Author

N70-36034# Forest Service, Washington, D.C.
FORESTER'S GUIDE TO AERIAL PHOTO INTERPRETATION
T. Eugene Avery (Ill. Univ., Urbana) Dec. 1969 44 p refs
Revised /ts Agr. Handbook No. 308
Avail: SOD \$0.75

This handbook was written as a practical reference on techniques of aerial photo interpretation in forest inventory. It is for the forester with a casual knowledge of the subject. While oblique photographs are occasionally useful for interpretation, this manual emphasizes stereoscopic interpretation of vertical aerial photographs. With training, the forester can use aerial photographs to locate property boundaries and trails, determine bearings and distances, identify classes of vegetation, and measure areas. Experience will enable him to improve the efficiency of forest inventories by distributing field samples on the basis of photo stratifications. In some instances, he may even be able to estimate timber volumes directly from the photographs. Author

N70-36236# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
AERIAL SENSING AND PHOTOGRAPHIC STUDY OF THE EL VERDE RAIN FOREST, PUERTO RICO Final Report, Sep. 1964 - Mar. 1967

Philip L. Johnson and David M. Atwood Dec. 1969 27 p refs
(AD-703123; CRREL-RR-250) Avail: CFSTI CSCL 2/6

Aerial and ground photographs were taken over a 2-year period of sites in the El Verde rain forest to record the consistency of the vegetational patterns in untreated sites and the changes that occurred following gamma irradiation. Four emulsions were used: panchromatic infrared, false color transparency and color transparency. Densitometry was used to evaluate color film and the vegetation response to 3 months of radiation. The color emulsions provided the sharpest indication of damage to vegetation and the succession following treatment. Hemispherical photography of the canopy was evaluated in terms of a canopy cover index defined as per cent of light passing through the negative in a 90-degree cone area. Control stations were remarkably constant in all photography, establishing the stability and slow natural changes in

rain-forest structure. Spectral light measurements within the forest confirmed the predominance of far red shade light. Compared to similar studies on the chronic irradiated forest at Brookhaven National Laboratory the El Verde results were less distinct. Author (TAB)

N70-37483# Illinois State Water Survey, Urbana.
INVESTIGATIONS OF CROP-HAIL LOSS MEASUREMENT TECHNIQUES

N. A. Barron, S. A. Changnon, Jr., and J. Hornaday 31 Jan. 1970 70 p refs Prepared for Crop Hail Insurance Actuarial Assoc., Chicago
(PB-189706; RR-42) Avail: CFSTI CSCL 02C

An exhaustive study of crop losses from a damaging hailstorm was pursued using: (1) detailed post-storm field measurements of loss as determined from standard adjusting techniques; (2) post-storm aerial photographs taken on different days using infrared color and standard color films; and (3) actual yield data from the damaged fields. The measurements of loss from the in-field adjustments at various sampling densities and from the film data were compared with each other and against the final losses reflected in the harvested yields. Film data taken over corn plots where various treatments to simulate hail damages were applied were also studied in a similar fashion. The primary aim of the project was to ascertain whether aerial infrared color photographs could provide objective and quantitative measures of crop-hail loss. Author (USGRDR)

N70-37990# Army Engineer Topographic Labs., Fort Belvoir, Va.

AN EVALUATION OF MULTIBAND AND COLOR AERIAL PHOTOGRAPHY FOR SELECTED MILITARY GEOGRAPHIC INTELLIGENCE IN A SUBTROPICAL DESERT ENVIRONMENT Technical Report, Jan. - Sep. 1968

Aulis O. Lind (Army Cold Reg. Res. and Eng. Lab.) Jan. 1970 109 p refs
(AD-707429; USAETL-54-TR) Avail: CFSTI CSCL 14/5

The objective of the work included in this report was to evaluate multiband and color photography with several film/filter combinations for their application to information extraction for Military Geographic Intelligence. Two studies were performed on aerial photography for which ground truth data was obtained in the Phoenix, Arizona, test area. One study concerned the derivation of terrain data from four film/filter combinations (Plus X with 47B, 58, and 25A filters; and Infrared with 89B filter). The second study was an evaluation of black-and-white, normal-color, and false-color imagery with regard to their information content. Details for each type of film/filter combination are given as well as a summary of the findings. Author (TAB)

N70-38885*# Geological Survey, Washington, D.C.
PRELIMINARY STUDIES OF SOIL PATTERNS OBSERVED IN RADAR IMAGES, BISHOP AREA, CALIFORNIA

Michael F. Sheridan (Ariz. State Univ.) Nov. 1966 8 p /ts Tech. Letter NASA-63

(NASA Order R-09-020-015)
(NASA-CR-80643) Avail: CFSTI CSCL 08G

Preliminary field studies of soil samples found within the Mt. Tom and Bishop quadrangles were made in an attempt to determine the relative moisture content and grain size of samples in the light and dark areas of radar images of the site, and to verify previously reported conclusions that the topographically lower, finer grained alluvial deposits have a darker shade than the alluvial deposits in fans and raised terraces presumably because of a higher near-surface water content. Qualitative evaluations of soil samples in nine localities showed no moisture at the surface or to a depth

of six inches. It is therefore concluded that moisture did not seem to be a factor in producing the dark imagery patterns; however, there was a very good correlation of grain size with darkness. There was a strong tendency for the dark areas to be irrigated and thus to have a much heavier cover of vegetation. Where the vegetation was heavy the imagery pattern was darker than the grain size of soil produced in areas with no vegetation or little vegetation. It is further concluded that grain size is the dominant factor in determining the darkness of the color patterns in the Bishop area.

S.C.W.

N70-38974* Geological Survey, Denver, Colo.

EXTENT OF RELICT SOILS REVEALED BY GEMINI 4 PHOTOGRAPHS

Harald Drewes and Roger Morrison Oct. 1966 19 p *Its Tech. Letter* NASA-60

(NASA Order R-09-020-011)

(NASA-CR-78775) Avail: CFSTI CSCL 08G

Synoptic observations of large areas, recorded in photographs taken from the Gemini 4 mission, indicate that color photographs from orbital altitudes offer certain unique advantages for determining the extent, correlation, and development of some types of soil. Reddish soils are the most conspicuous ones on the photographs and in general are old soils, that developed during intervals of reduced erosion and surficial deposition favorable for chemical weathering. Correlation of these soils would be a major factor in correlating Quaternary geologic events in separate drainage basins of the southwest with known interglacial events to the north.

Author

N70-38975* Geological Survey, Denver, Colo.

AN EVALUATION OF THE GEMINI 4 COLOR PHOTOS OF THE GULF OF CALIFORNIA-CENTRAL TEXAS AREA

Harald Drewes Oct. 1966 17 p *Its Tech. Letter* NASA-46

(NASA Order R-09-020-013)

(NASA-CR-78774) Avail: CFSTI CSCL 08G

On the Gemini 4 mission a series of overlapping photographs were taken June 5, 1965, from the Gulf of California to central Texas. The photographs chief value to geological interpretation lies in their fine definition of surficial deposits and some younger volcanic rocks. They also show, in a much less reliable way, some kinds of older sedimentary and igneous rocks, and show a little of the geological structure of the regions. The photos in Texas are oblique shots, which sufficiently distort large portions to impair their value as a geological tool. Three areas are selected for review to illustrate what geological interpretations can be made of different geologic terranes.

Author

N70-40222# Army Foreign Science and Technology Center, Washington, D.C.

MANUAL FOR USING AERIAL PHOTOGRAPHS IN SOIL MAPPING

A. P. Merishin 8 May 1970 52 p refs Transl. into ENGLISH from Metod. Rukovodstvo po ispolz. Materialov Aerofotosemki pri Pochv. Kartirovani (Moscow), 1964 p 1-64

(AD-708787; FSTC-HT-23-732-68) Avail: NTIS CSCL 8/3

The translation discusses the use of aerial photography in the mapping of soils. Much attention is given to the methods of interpreting soils by aerial photographs and to the study of interpreting soils by their distinctive characteristics in various zones and provinces. Several authors give their views on the interpretation of different soil characteristics such as those of alkali, saline, chestnut, meadow-chestnut, forest-steppe zones, forest and tundra zones, and swamps. The authors also point out that the application of aeromethods in the practice of large-scale soil mapping in the Soviet Union and abroad indicates the use of materials from

aerial survey increases considerably the accuracy of soil mapping, reduces the volume of the field work, cuts down its cost and increases the practical value of soil maps.

Author (TAB)

N70-41063* Oregon State Univ., Corvallis. Dept. of Range Management.

REMOTE SENSING APPLICATIONS IN FORESTRY: INVENTORY OF NATIVE VEGETATION AND RELATED RESOURCES FROM SPACE PHOTOGRAPHY Annual Progress Report

Charles E. Poulton, Edmundo Garcia-Moya, James R. Johnson, and Barry J. Schrupf Berkeley, Calif. Calif. Univ. 30 Sep. 1969 74 p refs Prepared in cooperation with Calif. Univ., Berkeley and Dept. of Agr. Forest Serv.

(NASA Order W-12996)

(NASA-CR-113805) Avail: NTIS CSCL 02F

Progress reported in a program of continuing research includes: (1) ground-truth support for the Apollo 9 mission and the SO65 and high-flight experiments; (2) acquisition of specialized ground-truth and preliminary evaluation of multiseasonal photography as an aid to vegetation interpretation; (3) development and testing of a symbolic legend concept for use in photo interpretation and the annotation of mapped delineations; (4) initial field work on development of an ecological ground-truth classification that is essential to detailed, quantitative, image-relationship studies and to legend refinement at levels required in vegetational management decisions; and (5) demonstration of the feasibility of vegetational resource analysis by aerial photography subsampling at various scales from initial stratifications on space photography. This latter step permits the complete, quantitative characterization of space-photo images of naturally vegetated landscapes.

Author

N70-41064* California Univ., Berkeley. Forestry Remote Sensing Lab.

REMOTE SENSING APPLICATIONS IN FORESTRY. THE IDENTIFICATION AND QUANTIFICATION OF HERBLAND AND SHRUBLAND VEGETATION RESOURCES FROM AERIAL AND SPACE PHOTOGRAPHY Annual Progress Report

Richard S. Driscoll (Rocky Mt. Forest and Range Expt. Station) 30 Sep. 1969 60 p refs Prepared in cooperation with Dept. of Agr.

(NASA Order W-12-998)

(NASA-CR-113802) Avail: NTIS CSCL 08F

Research is reported in a program to assess the merits of large-scale color and infrared color aerial photography for detecting and identifying herbaceous and shrubby plant species and communities at four test locations in Colorado. Added emphasis was placed on multistaged sampling techniques to quantify earth resources photography from space using Apollo 9 color infrared photographs of an area around Roswell, New Mexico, for base data. A multiple sampling technique involving subsampling is described whereby color infrared aerial photos at scales of 1:80,000, 1:20,000, and 1:2,400 are used to estimate the areal extent of the specific plant communities and to estimate specific plant species density. A photointerpretation key for shrubs was developed to compare film type and photoscale for identification of individual shrubs. Image characteristics used were class categories of crown shape, crown margin, foliage texture, foliage pattern, plant size, shadow, and color.

Author

N70-41162* Michigan Univ., Ann Arbor. School of Natural Resources.

REMOTE SENSING APPLICATIONS IN FORESTRY: REMOTE SENSING OF CHANGES IN MORPHOLOGY AND PHYSIOLOGY OF TREES UNDER STRESS Annual Progress Report

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Charles E. Olson, Jr., Jennifer M. Ward, and Wayne G. Rohde
Berkeley, Calif. Calif. Univ. 30 Sep. 1969 47 p refs Prepared
in cooperation with Calif. Univ., Berkeley and Dept. of Agr. Forest
Serv.

(NASA Order W-12996)

(NASA-CR-113803; APR-3) Avail: NTIS CSCL02F

Statistical evaluations of reflectance data for sugar maple
(*Acer saccharum*) indicated that remote detection of plant damage
due to salt accumulation is most likely at wavelengths between
1.43 and 2.19 micrometers. Significant increases in reflectance were
observed in the photographic infrared spectral region (0.8 to 1.2
micrometers) for low levels of salt, but not for high levels of
salt. Reflectance measurements made for foliage on watered and
unwatered yellow poplar (*Liriodendron tulipifera*) seedlings agree
with data previously reported. Leaves which reached full size before
watering ceased showed a slight increase in reflectance at most
wavelengths when the plants were subjected to severe moisture
stress. Leaves which unfolded under severe moisture stress were
less reflective at all wavelengths. White ash (*Fraxinus americana*)
leaves unfolding under severe moisture stress were more reflective
than leaves on watered plants, however. Results with sugar maple
were similar to those for ash. Radiometric temperatures were
consistently higher for stressed than unstressed plants. Author

N70-41164*# Pacific Southwest Forest and Range Experiment
Station, Berkeley, Calif.

**REMOTE SENSING APPLICATIONS IN FORESTRY: THE
USE OF MULTISPECTRAL SENSING TECHNIQUES TO
DETECT PONDEROSA PINE TREES UNDER STRESS FROM
INSECT OR DISEASES** Annual Progress Report

R. C. Heller, R. C. Aldrich, W. F. McCambridge, and F. P. Weber
Calif. Univ. 30 Sep. 1969 87 p refs

(NASA Order W-12996)

(NASA-CR-113804; PR-4) Avail: NTIS CSCL02F

Objectives of the research were: (1) to determine the best
film and scale combination for detecting small infestations 1-3
trees in size; and (2) to determine the limits for detecting bark
beetle infestations on space photography. The 15-channel
optical-mechanical scanner data collected by aircraft in May
1968 were processed and interpreted by several techniques. Ten
channels of spectrometer data were processed in an analog
multispectral processor. Four color coded film strips were produced
by the processor to represent each of four tree condition classes.
These films showed a good relationship in the faded uninfested
condition class between actual number of trees on the ground and
number of recognized targets. Individual waveband analysis showed
discriminating wavebands for old-kill and faded infested trees.
However, it required all 10 channels to detect nonfaded (previsual)
infested trees. Of three single-channel infrared processing
techniques, the gated analog method with reference-plate clipping
resulted in the best information for locating previsual beetle-attacked
trees. Author

N70-41217*# California Univ., Berkeley. Forestry Remote Sensing
Lab.

**REMOTE SENSING APPLICATIONS IN FORESTRY: THE
DEVELOPMENT OF SPECTRO-SIGNATURE INDICATORS
OF ROOT DISEASE IMPACTS ON FOREST STANDS** Annual
Progress Report

John F. Wear (Pacific Southwest Forest and Range Expt. Center)
and F. P. Weber (Pacific Southwest Forest and Range Expt.
Center) 30 Sep. 1969 62 p refs Prepared in cooperation with
Dept. of Agr.

(NASA Order W-12-996)

(NASA-CR-113895) Avail: NTIS CSCL02F

Remote sensing research was conducted to identify parameters
that best discriminate healthy Douglas-fir trees from those infected

with *Poria weirii* root-rot. Biophysiological investigations were
emphasized to gather data on emitted radiation from the two types
of tree crowns (healthy and diseased). Remote sensing in the
thermal infrared region shows great promise for the early detection
of root-rot infected trees. An aerial tramway system was designed
and installed for use as a remote sensing platform from which to
record continuous data. Two trams were needed because of the
difficulties involved in aligning trees in the natural second-growth
stand over which environmental data would be taken. The design
and installation procedures for establishing the tramway system
and the wide array of instrumentation needed in this phase of the
study are described and illustrated. A major objective of this remote
sensing research is to investigate the possibilities of detecting stress
trees on satellite imagery. Such a study was conducted with Apollo
9 photography and is described in this report. Author

N70-41262*# California Univ. Berkeley. Forestry Remote Sensing
Lab.

**REMOTE SENSING APPLICATIONS IN FORESTRY:
ANALYSIS OF REMOTE SENSING DATA FOR EVALUATING
FOREST AND RANGE RESOURCES** Annual Progress Report

Robert N. Colwell et al 30 Sep. 1969 211 p refs Prepared
in cooperation with Dept. of Agr.

(NASA Order W-12996)

(NASA-CR-113912) Avail: NTIS CSCL02F

The rationale is given for a systematic forestry remote sensing
research program. The unit organization of the laboratory that has
been developed in order to conduct a comprehensive program is
described, and a statement is given of the types of programs that
are investigated by the laboratory's five major units, which are: (1)
operational feasibility, (2) spectral characteristics, (3) image
enhancement and interpretation, (4) automatic image classification
and data processing, and (5) training. A maximum effort has been
made to relate remote sensing capabilities to user requirements,
based on the presumption that the primary user will be the actual
manager of earth resources. Author

N70-42044*# Pacific Southwest Forest and Range Experiment
Station, Berkeley, Calif.

**REMOTE SENSING APPLICATIONS IN FORESTRY: THE
DEVELOPMENT OF AN EARTH RESOURCES
INFORMATION SYSTEM USING AERIAL PHOTOGRAPHS
AND DIGITAL COMPUTERS** Annual Progress Report

Philip G. Langley, David A. Sharpnack, Robert M. Russell, and Jan
Van Roessel 30 Sep. 1969 49 p refs Prepared in cooperation
with California Univ., Berkeley

(NASA Order W-12996)

(NASA-CR-114121) Avail: NTIS CSCL02F

A preliminary systems analysis was completed specifying the
equipment and software packages needed to build the information
processing, storage and retrieval systems. Programs were written
for (1) the conversion of coordinate data from the map digitizer
to FORTRAN accessible form, (2) the thinning of coordinate data,
and (3) the closing of boundaries. A systems analysis and program
development are completed for testing image matching procedures
to be used for the automatic mapping of forest resources using
digitized stereopairs of aerial photographs. Also, a program package
for simulating scanned aerial photographs in various orientations
was written to test the effects of the three-directional rotations on
digital image matching procedures. Author

N70-42235*# Purdue Univ., Lafayette, Ind. Lab. for Applications
of Remote Sensing.

**[AGRICULTURAL APPLICATIONS AND REQUIREMENTS
PROGRAMS]** Quarterly Progress Report, 1 Apr.-30 Jun. 1969
30 Jun. 1969 81 p

(NASA Order W12-996; Contract USDA-12-14-100-9549(20))
(NASA-CR-110780; QPR-3) Avail: NTIS CSCL08F

Discussions were held during this quarter with numerous scientists in various disciplines of the natural sciences. Interest centered around the potential use of LARS techniques and facilities for research in geology, limnology, meteorology, ecology, geography, and civil engineering. Soil scientists associated with LARS and the Purdue University Department of Agronomy conferred with soil scientists of the Indiana Office of the Soil Conservation Service concerning methods of evaluating the use of multispectral data in surveying and mapping soils. Several factors were proposed for evaluating the utility of computer printouts which separate soils according to the spectral properties of the surface. Author

N70-42389* California Univ., Berkeley. Forestry Remote Sensing Lab.

REMOTE SENSING APPLICATIONS IN FORESTRY Quarterly Progress Report, 1 Oct.-31 Dec. 1969

31 Dec. 1969 52 p refs

(NASA Order W-12996)

(NASA-CR-110794) Avail: NTIS CSCL02F

Work performed and in progress is reported for each of the following studies: analysis of remote sensing data for evaluating wildland resources; the use of space photography for classifying forest and non-forest land and for detecting forest disturbances; inventory of native vegetation and related resources from space photography; identification and quantification of herbland and shrubland vegetation resources from aerial and space photography; comparative merits of multispectral, line scan data and aerial photography for the analysis and mapping of range resource features in selected shrub steppe and pinyon/juniper woodland ecosystems; vigor loss in conifers due to dwarf mistletoe; development of spectro-signature indicators of root disease on large forest areas; remote sensing of changes in morphology and physiology of trees under stress; use of multispectral sensing techniques to detect ponderosa pine trees under stress from insect or pathogenic organisms; and development of an earth resources information system using aerial photographs and digital computers. P.A.B.

N70-42626* Texas A&M Univ., College Station. Remote Sensing Center.

REMOTE SENSING OF CROP WATER DEFICITS AND ITS POTENTIAL APPLICATIONS: AN ANNOTATED BIBLIOGRAPHY

W. P. David Sep. 1969 52 p refs

(Grant NGL-44-001-001)

(NASA-CR-110830; RSC-06) Avail: NTIS CSCL08H

The feasibility of using remote sensors in detecting water deficits in plants is examined. Techniques for the remote sensing of crop water deficits are presented for planning efficient water resources management and deciding on the use and distribution of diverted irrigation water. Background information on the significance of crop water deficits to crop production, on the development and symptoms of crop water deficits, and on the energy environment of plants is presented. The characteristics of plants that influence both reflectance and emittance of electromagnetic or radiant energy are also included. Author

N70-42811* Texas A&M Univ., College Station. Remote Sensing Center.

REMOTE SENSING IN AGRICULTURE: AGRONOMIC SCIENCES: A SELECTED BIBLIOGRAPHY WITH ABSTRACTS

R. H. Griffin, II, comp. [1969] 156 p refs

(Grant NGL-44-001-001)

(NASA-CR-110867; RSC-08) Avail: NTIS CSCL08D

The objective of the bibliography is to bring together in one document abstracts of current reports on remote sensing in agriculture, with special emphasis placed on the area of soils and agronomic crops. Included are articles that range from suggested or possible agricultural uses of remote sensing to articles that deal primarily with the theory of measurement by a particular sensor. This search covers primarily the literature from 1967 to the present. Author

N71-11154* Geological Survey, Washington, D.C.

RELATION OF REMOTE SENSING TO TRANSPIRATION OF FLOOD PLAIN VEGETATION

Richard C. Culler and Raymond M. Turner. In NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 3 1969 8 p refs

Avail: NTIS CSCL08H

The amount of water vapor lost from plants through transpiration is in part a function of the volume of plant material covering a given area. If the variance in plant material through time and space is known, it should be possible to make certain inferences regarding the amount of transpiration through the same time period and over the same area. It is this varying plant volume that is measured by the use of readily available aerial photographic techniques and materials. Author

N71-11159* Geological Survey, Miami, Fla.

APPLICATIONS OF MULTISPECTRAL DATA COLLECTION AND PROCESSING TECHNIQUES APPLIED TO HYDROBIOLOGICAL INVESTIGATIONS IN EVERGLADES NATIONAL PARK, FLORIDA

Aaron L. Higer, Milton C. Kolipinski, Norma S. Thomas, and Fred J. Thomson. In NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 3 1969 27 p refs. Prepared in cooperation with Michigan Univ., Ann Arbor

Avail: NTIS CSCL08H

Mapping of hydrobiological features with multiband scanner imagery was tried for the first time on a strip of land eight miles long and 2,000 feet wide. This was done by electrically processing selected combinations of video signals in the narrow spectral bands between 0.4 and 1.0 micrometers to obtain recognition maps for tree islands, emergent aquatic grassland, and various surface-water depths. The computer recognition maps of individual hydrobiological features were printed in different colors and superposed to provide a color composite map of the area. This technique has potential for use in the hydrobiological evaluation of marsh, swamp and other shallow-water areas. Author

N71-11974* South Dakota State Univ., Brookings. Remote Sensing Inst.

REMOTE SENSING FOR DETECTION OF SOIL LIMITATIONS IN AGRICULTURAL AREAS Quarterly Report,

1 Apr.-1 Jul. 1970

Jun. 1970 22 p

(NASA Order W-12996)

(NASA-CR-111423) Avail: NTIS CSCL02D

Remote sensing methods, aerial reconnaissance, special cameras, and an infrared imager, were used to determine proper land use and land use limitations on a potential irrigation project. Multispectral photographs were used to establish pattern recognition techniques for identifying clay pan conditions and for classifying fields in land use patterns. Rapid scan, automatic interpretation techniques were developed from analog data and multispectral transparencies. E.H.W.

01 AGRICULTURE AND FORESTRY

N71-11976* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
SECOND ANNUAL EARTH RESOURCES AIRCRAFT PROGRAM STATUS REVIEW. VOLUME 2: AGRICULTURE/FORESTRY, AND SENSOR STUDIES
1969 479 p refs Conf. held at Houston, Tex., 16-18 Sep. 1969

(NASA-TM-X-66484) Avail: NTIS CSCL08F

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3. RANGE RESOURCE INVENTORY FROM SPACE AND SUPPORTING AIRCRAFT PHOTOGRAPHY C. E. Poulton, B. J. Schrumphf (Ore. State Univ.), and R. S. Driscoll (Rocky Mt. Forest and Range Expt. Station) 28 p

4. MULTIPLE RESOURCE INVENTORY ON SPACE AND HIGH-ALTITUDE PHOTOGRAPHY L. R. Pottinger (Calif. Univ., Berkeley) 19 p ref

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7. AUTOMATIC PROCESSING OF EARTH RESOURCE DATA D. A. Landgrebe (Purdue Univ.) 32 p

8. MULTISPECTRAL DATA COLLECTION AND INSTRUMENTATION STUDIES D. S. Lowe (Mich. Univ., Ann Arbor) 13 p refs

9. AIRBORNE INFRARED SPECTRAL STUDY OF IGNEOUS ROCKS IN SONORA PASS TEST SITE I. A. Kilinc and R. J. P. Lyon (Stanford Univ.) 19 p refs

10. NASA SUPPORTED REMOTE SENSING ACTIVITIES AT THE UNIVERSITY OF MICHIGAN WILLOW RUN LABORATORIES ANNUAL REPORT, Sep. 1969 M. R. Holter (Mich. Univ., Ann Arbor) 36 p ref

11. USE OF PASSBAND INTERFERENCE FILTERS IN MULTISPECTRAL PHOTOGRAPHY P. N. Slater and D. B. McKenney (Arizona Univ., Tucson) 18 p refs

12. MULTISPECTRAL VIEWERS E. Yost (Long Island Univ., Greenvale, N.Y.) 28 p refs

13. MICROWAVE STUDIES AND INSTRUMENTATION FOR THE EARTH RESOURCES PROGRAM J. C. Blinn, III (JPL, Calif. Inst. of Tech.) 3 p

14. GROUND TRUTH/SENSOR CORRELATION P. Chapman, J. Quade, P. Brennan (Nev. Univ.), and J. C. Blinn, III (JPL) 28 p refs

15. RADAR AND DATA PROCESSING R. K. Moore (Kansas Univ., Lawrence) 28 p refs

16. RECENT PROGRESS IN TANK, SHIPBOARD, AND HELICOPTER TESTS OF THE FRAUNHOFER LINE DISCRIMINATOR G. E. Stoertz and W. R. Hemphill (Geol. Surv., Wash., D.C.) 30 p refs

17. EXPERIMENTAL RESULTS IN THE REMOTE SENSING OF GASES FROM HIGH ALTITUDES A. R. Barringer and J. H. Davies (Barringer Res., Ltd., Dowagiac, Mich.) 31 p

N71-11977* California Univ., Berkeley. Forestry Remote Sensing Lab.

THE INVENTORY OF VEGETATION RESOURCES: USER

REQUIREMENTS VERSUS REMOTE SENSING CAPABILITIES

Robert N. Colwell In NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 2 1969 71 p refs

Avail: NTIS CSCL08F

The different approaches which may be applied in relating user requirements with remote sensing capabilities are discussed. Examples are given of agricultural and forest resources requirements to illustrate both the broad and narrow viewpoints of user requirements. Two kinds of photography are compared to evaluate the remote sensing capabilities provided by aircraft and spacecraft. The first type is multiband space photography of various earth resource test sites in the U. S. taken from an altitude of about 110 nautical miles by Apollo 9 astronauts, and the second type is multiband aerial photography taken of the same sites from an altitude of approximately 70,000 feet at the same time of the Apollo 9 overflight, and at monthly intervals afterwards. The studies show that, while one type of observation may provide more information than another, a multistage sampling technique which employs spacecraft, aircraft, and ground observations is the most suitable for operational earth resources surveys of the future. R.B.

N71-11978* Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.

MULTI-STAGE SAMPLING OF FOREST RESOURCES BY USING SPACE PHOTOGRAPHY

Philip G. Langley, Robert C. Aldrich, and Robert C. Heller In NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 2 1969 21 p refs

Avail: NTIS CSCL02F

The exploration of earth resources from space can lead to the development of a dynamic forest resources information system based on imagery obtained from remote sensors and newly developed sampling techniques. A pilot timber inventory was conducted on 10 million acres of land in Arkansas, Georgia, Louisiana, and Mississippi by using photography taken from the Apollo 9 spacecraft. To increase sampling efficiency, the photos were used 1/60,000 scale Plarioid, 1/12,000 scale 70 mm, and 1/2,000 scale 70 mm color aerial photos in a stratified five-stage probability sampling design. This design yields unbiased estimates that are independent of the quality of the imagery. Sampling errors are, however, inversely related to the quality of the photo data. The best results were obtained on 5 million acres in the Mississippi Valley area, where a 58 percent reduction in sampling error was attributed to information obtained from the Apollo 9 photography. The sampling design can be used to survey agricultural as well as forestry resources from space. Author

N71-11979* Oregon State Univ., Corvallis.

RANGE RESOURCE INVENTORY FROM SPACE AND SUPPORTING AIRCRAFT PHOTOGRAPHY

Charles E. Poulton, Richard S. Driscoll (Rocky Mt. Forest and Range Expt. Station), and Barry J. Schrumphf In NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 2 1969 28 p

Avail: NTIS CSCL08F

Interim results and progress on the use of space and aircraft photography for range resource inventories are reviewed. Preliminary guidelines on vegetational mapping and a legend concept by which the information can be conveyed to the user are presented. A multistage sampling procedure to obtain data needed for detailed interpretation of space photography is explained. The same procedure permits explanation of the makeup of the vegetational units interpreted from space photography. The potential contribution of multiseasonal photography in photointerpretation is discussed. Author

N71-11980*# California Univ., Berkeley. School of Forestry and Conservation.

MULTIPLE RESOURCE INVENTORY ON SPACE AND HIGH-ALTITUDE PHOTOGRAPHY

Lawrence R. Pettinger / In NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 2 1969 19 p refs

Avail: NTIS CSCL 08F

The potential for making broad land use maps and earth resource surveys was evaluated using Apollo 9 space photographs, and small-scale photographs obtained by high altitude aircraft. It is shown that several different photointerpretation procedures can be integrated to extract information from space and aerial photographs on several resources within a single geographic area. Specific techniques are discussed for the inventory of agricultural, range, geologic, and hydrologic resources. In each case, a particular set of interpretation procedures were chosen depending on the nature of the resource. Color composite images, both optical and electrical, were prepared to enhance differences between crop types. Interpretation tests are described that are used to evaluate how well crop types can be identified on the various space and sequential high altitude photographs, as well as color composite images made from these photographs. Author

N71-11981*# Agricultural Research Service, Weslaco, Tex. Soil and Water Conservation Research Div.

INTERACTION OF ELECTROMAGNETIC ENERGY WITH AGRICULTURAL CROPS

Craig L. Wiegand, Harold W. Gausman, William A. Allen; and Ross W. Leamer / In NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 2 1969 14 p refs

(NASA Order R-09-038-002)

Avail: NTIS CSCL 08F

The remote sensing research program of studying the interaction of electromagnetic radiation with plants, soils, and water, and wavelengths and procedures for discriminating agricultural crops is discussed. Absolute spectrophotometric data indicate that over the wavelength interval 500 to 1400 nanometers (nm), leaf signature is mainly a function of leaf pigments and structure, and growth stress conditions cause a rounding of the reflectance plateau in the wavelength interval 750 to 900 nm. The discrimination of crop species based on infinite reflectance was very successful for the wavelength interval 1300 to 2200 nm. Two pattern recognition techniques, the minimum distance to the mean and statistical pattern recognition, were investigated. Advances in photographic transparency quantization and analysis are illustrated using Apollo 9 SO-65 experiment and aircraft imagery. The techniques involve use of optical density differences among densities measured with different bandpass filters in the light beam and no filter in the light beam. The procedures have been computerized for crop and soil condition discrimination. Author

N71-11982*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

APPLICATION OF AUTOMATIC RECOGNITION TECHNIQUES TO EARTH RESOURCES

R. B. MacDonald / In NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 2 1969 27 p refs

Avail: NTIS CSCL 08F

A multidisciplinary program designed to explore critical problem areas in agricultural applications is discussed. The program is organized into research areas of biogeophysics, measurements, data processing, requirements and applications, and aerospace systems analysis. Biogeophysical research teams are organized to deal with problems of vegetation, soils, and water. The primary objectives of

the research are to correlate remotely sensed measurements to physical and chemical properties of radiating scenes. The results of research to apply advanced remote sensing and processing techniques to agricultural situation are discussed. Author

N71-11994*# Department of Agriculture, Washington, D.C.

[SOIL PHOTOGRAPHIC MAPPING] Periodic Report, 1 Jan.-30 Jun. 1970

30 Jun. 1970 16 p

(NASA Order W-12996)

(NASA-CR-111418) Avail: NTIS CSCL 08E

Pattern recognition and soil mapping studies pertaining to soil classification are discussed. Reports from the photography laboratory, APT satellite tracking station, and mission records are included. Development of an automatic pattern recognition system that is useful for analysis and feature development, feature selection, and classification of remote sensing data is reported. The usefulness is determined of spot density readings made on Ektachrome infrared film for the classification of crops. Author

N71-14879# Utah State Univ., Logan. Center for Water Resources Research.

SPECTRAL INFRA-RED REFLECTION MEASUREMENTS FROM NATURAL AND TREATED ASPEN FORESTS Progress Report

Frank W. Haws, Ralph Briscoe, and Allan Steed Dec. 1969 20 p refs Sponsored by Dept. of Interior

(PB-192209; W70-07332; CWRR-14-4) Avail: NTIS CSCL 02F

Spectral reflectance measurements were made during the summers of 1967 and 1968 on a natural stand of aspen in Utah, part of which was treated with foliar chemicals. The reflectance from the vegetation due to various environmental changes was highly wavelength dependent. The laboratory measurements showed a definite decrease in infrared reflectance as the soil moisture was depleted. The field measurements in the natural watershed showed a similar reduction in infrared reflectance after a considerable number of days without precipitation. USGRDR

N71-15001*# Kansas Univ., Lawrence. Center for Research.

AN EVALUATION OF FINE RESOLUTION RADAR IMAGERY FOR MAKING AGRICULTURAL DETERMINATIONS

S. A. Morain and J. Coiner, Houston, Tex. NASA. Manned Spacecraft Center Dec. 1970 48 p refs Reprinted (Contract NAS9-102611)

(NASA-CR-115858; MSC-03708; CRES-TR-177-7) Avail: NTIS CSCL 17I

The results of two type of analyses performed on high resolution imagery are presented. The first analysis is strictly a visual interpretation of the imagery with its major objective being to explore possibilities for creating identification keys for crop types and states. The second approach focuses on extracting quantalog spot densities from X-1 resolution and investigating, through a set of categorization strategies, various ways of presenting the data. A series of scattergrams are presented representing each of the grouping strategies. The results of the two analyses, while inconclusive, are moderately encouraging and the significance of the information obtained is summarized. D.L.G.

N71-15497# Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.

FOREST AND RANGE INVENTORY AND MAPPING

Robert C. Aldrich [1970] 30 p refs

Avail: Issuing Activity

01 AGRICULTURE AND FORESTRY

Applications and uses of remote sensing techniques for forest sampling and mapping are discussed. Methods include aircraft, spacecraft, and electronic sensors. A comparison of sampling and probability sampling theories shows probability sampling has the advantages of (1) eliminating costly ground samples, (2) being more efficient, (3) providing unbiased estimates, (4) providing statistically valid sampling errors at all stages, and (5) improving operational efficiency. Sample photographs are included. E.H.W.

N71-15502# Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.

DETECTION AND CHARACTERIZATION OF STRESS SYMPTOMS IN FOREST VEGETATION

Robert C. Heller [1969] 55 p refs

Avail: NTIS

Aerial color photography was used to detect and locate areas of forest timber under vegetative stress caused by bark beetles. Evaluated were combinations of films; scales, and filters for remote sensing of injured trees from aircraft and the possibility to detect stressed trees before visual symptoms of decline occurred. Infrared multispectral line scanner photos were interpreted for small scale color and infrared color transparencies of foliage and compared with ground observations. It was concluded that stress induced on forest vegetation is best detected when symptoms exhibit foliage discoloration by using color or false-color photography. G.G.

N71-15653# Comissao Nacional de Atividades Espaciais, Sao Tose Dos Campos (Brazil).

REMOTE SENSING PROJECT. PHASE C: AGRICULTURE Final Report

A. G. De Souza Coelho and Hector W. McNeill Sep. 1970 102 p refs

(LAFE-132) Avail: NTIS

Brazilian agricultural remote sensing research projects are described. Subjects discussed are: (1) field measurements, (2) coffee spacing, (3) soils, (4) soil nutrient status, (5) land use capability, (6) yield prediction, (7) primary yield evaluation, (8) tolerance theory, (9) system for crop boundary and natural vegetation, and (10) boundary recognition. Author

N71-16130*# Georgia Univ., Athens.

REMOTE SENSING OF FIRE PHENOMENA IN TROPICAL GRASSLANDS: THE FLORIDA TEST SITES, 1967 - 1968

Merle C. Prunty / In NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 1 1968 11 p refs

Avail: NTIS CSCLO8F

Modifications in vegetative cover caused by ground fires were recorded during overflights, at differing heights by remote color infrared imagery and compared with ground control mappings. It was found that recognition and distribution of ground fire areas was accurately determined even on sites with dense forest covers; results from 15,000-foot height infrared film were virtually identical to those from exposures at 3000 feet. G.G.

N71-16147*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

EARTH RESOURCES AIRCRAFT PROGRAM STATUS REVIEW. VOLUME 2: AGRICULTURE, FORESTRY, AND SENSOR STUDIES

1968 452 p refs Conf. held at Houston, Tex., 16-18 Sep. 1968

(NASA-TM-X-62565) Avail: NTIS CSCLO8F

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5. REFLECTANCE PRODUCED BY A PLANT LEAF W. A. Allen, A. J. Richardson, and H. W. Gausman (Agricultural Res. Ser., Weslaco, Tex.) 13 p refs

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8. PHYSICAL MEASUREMENTS PROGRAMS AT LARS-PURDUE R. A. Holmes (Purdue Univ.) 24 p refs

9. RADAR AS A SENSOR IN AGRICULTURE D. S. Simonett (Kansas Univ., Lawrence) 28 p refs

10. WILDLAND RESOURCE INVENTORIES UNDER THE NASA EARTH RESOURCES SURVEY PROGRAM W. C. Draeger (Calif. Univ., Berkeley) 10 p

11. DEVELOPING SPECTROSIGNATURE INDICATORS OF ROOT DISEASE ON LARGE FOREST AREAS J. F. Wear (Pacific Southwest Forest and Range Experiment Sta.) 11 p

12. DETECTION OF FOREST INSECT OUTBREAKS BY REMOTE SENSING R. C. Heller (Agriculture Dept., Berkeley, Calif.) 62 p refs

13. THE IDENTIFICATION OF WESTERN FOREST SPECIES BY MEANS OF REMOTE SENSING D. T. Lauer (Calif. Univ., Berkeley) 16 p

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15. THE FEASIBILITY OF INVENTORYING NATIVE VEGETATION AND RELATED RESOURCES FROM SPACE PHOTOGRAPHY C. E. Poulton (Oregon State Univ.) 24 p refs

16. RESULTS OF EARTH RESOURCE INVESTIGATIONS M. R. Holter (Michigan Univ., Ann Arbor) 21 p

17. RADAR PROGRESS IN THE NASA EARTH RESOURCES AIRCRAFT PROGRAM R. K. Moore (Kansas Univ., Lawrence) 51 p

18. INFRARED STUDIES D. S. Lowe (Michigan Univ., Ann Arbor) 17 p

N71-16148*# California Univ., Berkeley. Forestry Remote Sensing Lab.

PHOTOGRAPHIC STUDIES AND APPLICATIONS OF THE NASA EARTH RESOURCES SURVEY PROGRAM

Robert N. Colwell / In NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 2 1968 35 p

Avail: NTIS

The various photographic studies performed and the applications found by investigators working on the NASA Earth Resources Survey Program in the fields of agriculture, forestry, and

range management are described. Discussed in detail are: agricultural and forestry uses of sequential photography; feasibility of delineating meaningful resource boundaries on space photography; multiband photographic experiments; construction of photointerpretation keys; and preliminary tests of operational feasibility. A.L.

N71-16149*# Department of Agriculture, Washington, D.C.
INTEGRATION OF DETAILED LABORATORY AND FIELD STUDIES WITH THE AIRCRAFT PROGRAM

Victor I. Myers and Ross W. Leamer *In* NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 2 1968 22 p

Avail: NTIS CSCL08H

In determining plant and soil signatures, certain characteristics of color transparencies have not been fully exploited. Extraction of hue, value, and chroma can yield signatures of earth resources with tremendous potential for identifying earth objects from spacecraft or aircraft. Apollo 502 and NASA aircraft mission 75 color photography were subjected to spectrophotometric analysis to extract signatures of earth objects. Results showed that there was a substantial effect of sun elevation (time of day) on total illumination and shading of exposed soil. The combination of microdensitometer and statistical procedures employed in this study should greatly enhance the opportunity for intelligent interpretation of aircraft and spacecraft photography. A.L.

N71-16150*# Agricultural Research Service, Weslaco, Tex.
CROP AND SOIL IDENTIFICATION FROM AERIAL PHOTOGRAPHS

R. W. Leamer and D. A. Weber *In* NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 2 1968 4 p

Avail: NTIS CSCL08H

Results of preliminary examinations of aerial photographs taken in midsummer 1968 at Weslaco, Texas are summarized. These photographs were analyzed in an effort to determine if crop and soil identifications could be made for photographic imagery. Measurement and interpretation of photographic film at Weslaco is being automated by use of a isodensitracer with a digital encoder, and a paper tape punch attachment. A.L.

N71-16151*# Agricultural Research Service, Weslaco, Tex.
REFLECTANCE AND STRUCTURE OF CYCOCOL-TREATED COTTON LEAVES, GOSSYPIUM HIRSUTUM L

H. W. Gausman, R. Cardenas, W. A. Allen, V. I. Myers, and R. W. Leamer *In* NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 2 1968 9 p refs

Avail: NTIS CSCL02A

Cycoccol induced changes in the internal structure of cotton leaves and their relation to reflectance, transmittance, and absorbance of near infrared light were investigated. Cycoccol treated leaves had more intercellular spaces in the spongy parenchyma which caused increased reflectance and decreased transmittance, particularly over the 750 micron to 1350 micron range in which the influence of internal leaf structure is highly important. Understanding the relation of light reflectance to the internal structure of leaves will be helpful in interpreting data obtained from aircraft and satellites. A.L.

N71-16152*# Agricultural Research Service, Weslaco, Tex.
RELUCTANCE PRODUCED BY A PLANT LEAF

W. A. Allen, A. J. Richardson, and H. W. Gausman *In* NASA.

Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 2 1968 13 p refs.

Avail: NTIS CSCL02A

Proper interpretation of multispectral imagery acquired from the NASA aircraft depends upon reliable ground truth information. In the case of vegetation, ground truth information can be reduced, in part, to effective optical parameters determined from individual leaves. Correlations can be, and have been, made between multispectral imagery acquired from the NASA aircraft and effective optical parameters measured in the laboratory. Author

N71-16153*# Purdue Univ., Lafayette, Ind. Lab. for Agricultural Remote Sensing.

BIOPHYSICAL RESEARCH AT LARS-PURDUE

Roger M. Hoffer *In* NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 2 1968 28 p

Avail: NTIS CSCL06C

The Laboratory for Agricultural Remote Sensing (LARS) was founded to plan and conduct research on data collection, data processing, and data distribution techniques which permit the rapid collection of accurate information important to the management of agricultural resources. Much of the work at LARS has centered around photographic and multispectral optical-mechanical scanner data. The primary advantage of optical-mechanical scanner data is in the ease and accuracy with which the data can be quantized and then processed and analyzed by computer. The advantages of automatic data processing of operational remote sensed information in agriculture would be the capability of obtaining data rapidly over large geographical areas and the timely processing of such data to useful information with accompanying benefit in improved accuracy, timeliness, and possible economy of agricultural surveys. A.L.

N71-16156*# Kansas Univ., Lawrence. Dept. of Geography and Center for Research in Engineering Science.

RADAR AS A SENSOR IN AGRICULTURE

D. S. Simonett *In* NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 2 1968 28 p refs

Avail: NTIS CSCL17I

The only radar frequency for which acceptable data have been obtained to date in the Earth Resources Program is K-band. Using these data, the effect of crop type, cover, moisture, and other parameters on radar return of the Garden City, Kansas, test site has been evaluated. Results of the tests indicate: (1) Statistical analysis shows that the type of crop is the most important variable influencing radar return. (2) Major influences on radar return are crop height, percent of ground covered by vegetation, and row height. (3) Crop moisture requires further study. (4) Soil moisture, even for bare ground, shows small influence on radar return during a single month. (5) Some crops depolarize an incident-polarized beam to a different degree than others. (6) Electronic color combining of multiple polarization imagery will aid in crop discrimination. A.L.

N71-16157*# California Univ., Berkeley. School of Forestry and Conservation.

WILDLAND RESOURCE INVENTORIES UNDER THE NASA EARTH RESOURCES SURVEY PROGRAM

William C. Draeger *In* NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 2 1968 10 p

Avail: NTIS CSCL08F

01 AGRICULTURE AND FORESTRY

Most of the NASA sponsored research concerned with wildland resource inventories has been centered in the Bucks Lake Test Site in the Sierra Nevada Mountains of California. Emphasis has been placed on the wildland vegetation resources in this primarily forested area. One research objective has been to define the optimum image specifications for inventorying the various vegetation types and other wildland resources on small scale imagery. From an interpretation of such imagery, the feasibility of identifying representative resource features in the Bucks Lake Test Site has been determined. Author

N71-16158*# Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.

DEVELOPING SPECTROSIGNATURE INDICATORS OF ROOT DISEASE ON LARGE FOREST AREAS

John F. Wear /in NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 2 1968 11 p

Avail: NTIS CSCL06C

Losses to forest diseases are more serious threats to the forest natural resource than either fire or insects. It is of continuing importance to develop remote sensing techniques that will collect data rapidly on pest problems from aircraft and orbiting platforms. Expanded research on the spectral emission and the spectral reflectance properties of specific forest types and on the physiological parameters of healthy and root-rot-infected trees are of great potential value in analyzing this serious forestry problem. Considerable progress has been made in the development of remote sensing techniques for efficient disease detection surveys that may eventually become an integral part of resource surveys from orbital altitudes. Author

N71-16159*# Agriculture Dept., Berkeley, Calif. Forest Service.
DETECTION OF FOREST INSECT OUTBREAKS BY REMOTE SENSING

R. C. Heller /in NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 2 1968 62 p refs

Avail: NTIS CSCL06C

Studies are underway in the Black Hills of South Dakota to determine the ground instrumentation, aerial sensing equipment, and techniques required to detect vigor loss and previsual signs of tree mortality caused by bark beetles in coniferous timber stands. Ground data have been collected on spectral reflectance, Munsell color notations, emitted and absolute temperature, transpiration, and needle moisture tension of ponderosa pine trees and foliage. Aerial photography (color and infrared color) was taken over six ground instrumented test sites at seven periods to capture changes in foliage coloration. Optical-mechanical scanning imagery was obtained in three wavebands (2.0 to 2.6 microns, 4.5 to 5.5 microns, and 8.0 to 14.0 microns). To date, no aerial sensor has been successful in detecting stressed conifers before the foliage discolors. No differences in photointerpretation accuracies have been found between color and false-color films. Scanners with better optical qualities exhibiting improved spatial and thermal resolution are needed before thermal techniques can be used with any degree of confidence. Author

N71-16160*# California Univ., Berkeley. School of Forestry and Conservation.

THE IDENTIFICATION OF WESTERN FOREST SPECIES BY MEANS OF REMOTE SENSING

Donald T. Lauer /in NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 2 1968 16 p

Avail: NTIS CSCL06C

Systematic analysis of several factors governing the interpretability of tree species on high altitude, small scale imagery

obtained by remote sensing was conducted. This research has sought, in particular, to determine which image characteristics are most useful for identifying the major tree species and timber types that occur in the western United States. Data acquired from the NASA aircraft are discussed and illustrated in the form of certain advanced techniques such as: (1) acquisition of sequential imagery, (2) acquisition of spectrozonal imagery, and (3) false color image enhancement of multiband imagery. In addition, a comparison has been made to determine the ease with which tree species composition, timber-type boundaries, and cultural patterns can be interpreted on Gemini photography and on a 10- by 15-foot aerial photographic mosaic comprised of 3200 conventional aerial photographs suitably reduced in scale. Author

N71-16161*# California Univ., Berkeley. School of Forestry and Conservation.

REMOTE-SENSING APPLICATIONS FOR THE INVENTORY OF RANGE RESOURCES

David M. Carnegie /in NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 2 1968 27 p

Avail: NTIS CSCL06C

Department of Agriculture - NASA sponsored research which investigates the feasibility of applying remote sensing, either from aircraft or spacecraft, as a tool for the inventory and management of range resources is summarized. Primary concern was focused upon: (1) the results from analyses of remote sensing data procured by NASA - Houston aircraft; (2) applications and possible benefits to accrue from remote sensing; and (3) relationships between aircraft-program and space-obtained remote sensing data. Author

N71-16162*# Oregon State Univ., Corvallis.
THE FEASIBILITY OF INVENTORYING NATIVE VEGETATION AND RELATED RESOURCES FROM SPACE PHOTOGRAPHY

Charles E. Poulton /in NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 2 1968 24 p refs

Avail: NTIS CSCL06C

Utilizing data acquired from NASA aircraft and Gemini 4 photography, the investigation is attempting to: (1) determine the potentialities and limitations of mapping and interpreting characteristics of native vegetation areas from space photography; (2) compare vegetation maps prepared from this photography with other available vegetation-resource maps; and (3) identify problems and limitations in the practical use of space photography in earth resources applications. Progress achieved on this investigation is summarized. A.L.

N71-17834*# Army Cold Regions Research and Engineering Lab., Hanover, N.H.

GEOMORPHOLOGIC INTERPRETATION FOR LANDSCAPE STUDIES

I. A. Volkov 1970 4 p Transl. into ENGLISH from the book "Primenenie Aerometodov Primenenie v Landshaftnykh Issledovaniyakh" Moscow-Leningrad, Akad. Nauk SSSR, Laboratorii Aerometodov, 1961 p 253 254

(AD-715050: FSTC-HT-23-553-68) Avail: NTIS CSCL 8/6

At the present time, Soviet physical geography shows a condition from general, comparatively cursory descriptions of extensive areas to a more fundamental thorough study of small sections of territory of Russia with a detailed analysis of the correlations in their development and mapping. The geologic structure and relief determine greatly the area distribution of large

geographic units (for example, provinces, geographic zones). Of still greater importance is the study of the specific features of the geologic structure and relief and detailed geographic studies which are accompanied by more detailed demarcation, that is, in landscape studies proper. These components of the landscape exert a deep influence on local relationships of heat and moisture and predetermine to a considerable degree the area disposition of the boundaries, the morphologic composition and structure of the landscape itself as well as its components. Author (GRA)

Merle C. Prunty *In* NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 1 1969 12 p

Avail: NTIS HC\$6.00/MF\$0.95 CSCL08G

Data for the analysis of the occurrence, areally and temporally, of grassland or ground fires in tropical savannas are presented. The maintenance of the savanna vegetation type is believed to be primarily a function of ground fires. Recurrent ground fires are characteristic of savannas everywhere and apparently have been so for thousands of years. Although the role of fires in maintaining the ecology of savannas is known from numerous studies of small savanna areas, there is little uniformity, hence areal or temporal comparability among these studies. Remote sensing of ground fire phenomena from satellite platforms can provide observations that are standardized as to observational procedures, quality and time, and are both areally comprehensive and inclusive. Particularly, such observations can encompass large areas in a uniform manner. Author

N71-21503# Oregon State Univ., Corvallis. Range Management Program.

AN ANALYSIS OF STATE OWNED RANGELAND RESOURCES FOR MULTIPLE USE MANAGEMENT IN SOUTHEASTERN OREGON

Charles E. Poulton and Arleigh G. Isley Aug. 1970 132 p refs
Avail: Issuing Activity

Selected information and statistical summaries essential to convey a picture of the kind and potential of the rangeland held by the State and needed for administrative levels for policy formulation and broad program guidance are presented. The opportunities in resource development and management of the lands are described, and the size of the land management and rehabilitation program that may be involved is indicated. Summarized data are given by county and by ecological province. Physical and vegetational resources, improvement and development potential, existing physical facilities, retain-dispose management level suggestions, and specific recommendations are discussed. N.E.N.

N71-23731 + Purdue Univ., Lafayette, Ind. Lab. for Agricultural Remote Sensing.

AUTOMATIC IDENTIFICATION AND CLASSIFICATION OF WHEAT BY REMOTE SENSING Research Progress Report

David A. Landgrebe Mar. 1967 7 p *Its* LARS Inform. Note No. 21567

(Rept-279) Avail: NTIS

Early results in the automatic classification of crops from airborne multispectral data are presented for agricultural remote sensing. The specific problem treated is the automatic detection of wheat in late June. Results discussed are contained on the four computer printouts which may be interpreted with the aid of the aerial photograph showing the flight line. Author

N71-23808# Rice Univ., Houston, Tex. Dept. of Geology. **DEVELOPMENT OF REMOTE METHODS FOR OBTAINING SOIL INFORMATION AND LOCATION OF CONSTRUCTION MATERIALS USING GAMMA RAY SIGNATURES FOR PROJECT THEMIS Semiannual Report**

J. A. S. Adams, H. C. Clark, R. B. Clark, B. G. Cook, and J. S. Duval 15 Dec. 1970 274 p refs
(Contract DACA39-69-C-0048)

(AD-718519) Avail: NTIS CSCL 8/7

A major emphasis in recent years has been the development, calibration, and field testing of airborne gamma-ray spectrometer systems, particularly with the low levels and slow speeds attainable with helicopters. The research described in the following pages is

N71-18408*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

TERRAIN PHOTOGRAPHY FROM GEMINI SPACECRAFT Final Geologic Report

Paul D. Lowman, Jr. and Herbert A. Tiedemann Jan. 1971 79 p refs

(NASA-TM-X-65451; X-644-71-15) Avail: NTIS CSCL 14E

The objectives, methods, equipment, and main geologic results of the Synoptic Terrain Photography Experiment (S005) carried out by the astronauts during several Gemini missions in 1965 and 1966 are summarized. The objective of the S005 experiment was to obtain 70 mm color photographs of the earth's surface for geologic, geographic, or oceanographic study. The pictures were taken using hand-held cameras with 38 mm, 80 mm, and 250 mm focal length lenses; approximately 1100 photographs usable for geologic purposes were obtained, covering various areas between 32 N and 32 S. Geologic applications of the photographs are discussed. Author

N71-19268*# Geological Survey, Denver, Colo.

REMOTE DETECTION OF GEOCHEMICAL SOIL ANOMALIES

F. C. Canney *In* NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 1 1969 8 p

Avail: NTIS HC\$6.00/MF\$0.95 CSCL08M

The spectral reflectance from trees growing in soil over a mineral deposit was compared with reflectance from trees of the same species growing in a nearby unmineralized area. Although the measurements were made on a relatively small number of trees, some significant differences were obtained and the overall results are encouraging enough to warrant additional studies. Preliminary results suggest that measurement of spectral reflectance may become a new way of detecting geochemical soil anomalies by remote means in tree-covered areas. Author

N71-19262*# Geological Survey, Washington, D.C.

SUMMARY OF OBJECTIVES AND PROGRESS IN THE GEOGRAPHIC APPLICATIONS PROGRAM

Arch C. Gerlach *In* NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 1 1969 12 p

Avail: NTIS HC\$6.00/MF\$0.95 CSCL08E

Satellite remote sensing and data acquisition methods are described that proved most effective in applied geographical research. General accomplishments include soil and vegetation mapping, land use research for urban planning, ground water and fire detection, and plant disease identification. G.G.

N71-19263*# Georgia Univ., Athens.

REMOTE SENSING ANALYSIS OF GRASSLAND FIRE PHENOMENA: THE FLORIDA TEST SITES, 1968-1969

01 AGRICULTURE AND FORESTRY

directed toward three main end uses: terrain analysis, including the characterization of soils and rocks on the basis of their thorium, uranium, and potassium contents; trafficability; building materials, e.g. limestone with optimum clay content for cement; soil moisture; direct exploration for economic deposits of thorium and uranium; indirect mineral exploration for minerals associated with radioactive minerals, e.g. placer gold, or with potassium alteration, e.g. copper; rapid location and assessment of fission product contamination of the environment.

Author (GRA)

N71-24439# Danish Meteorological Inst., Copenhagen.
PHENOLOGICAL RESEARCH IN GREENLAND Final
Technical Report, 1964-1970
Ingolf Sestoft May 1970 30 p refs
(Contract DA-91-591-EUC-3341)
(AD-719720: ARDG(E)-E-948) Avail: NTIS CSCL 4/2

The report contains a study in phenology. It has been carried out under the cooperative auspices of the Danish Government and the U.S. Army's European Research Office. In this study was made of the correlation between the life cycles of certain Arctic plants, especially planted in S.W. Greenland, and the prevailing meteorological and climatic factors and conditions obtaining there. The objective was to determine to what extent such conditions may be ultimately predicted from observations of plant growth alone. Although the period of years spanned (1964-1970) is too short to draw firm conclusions, tentative correlations are drawn and set forth in the report.

Author (GRA)

N71-25015*# Agricultural Research Service, Weslaco, Tex. Soil and Water Conservation Div.
REMOTE SENSING IN EVAPOTRANSPIRATION RESEARCH ON THE GREAT PLAINS
Craig L. Wiegand and Jon F. Bartholic /in Kans. State Univ. Evapotranspiration in the Great Plains Seminar 25 Mar. 1970 p 137 180 refs
(NASA-Order R-09-038-002)
(NASA-CR-118184) Avail: NTIS HC \$6.00/MF \$0.95 CSCL 08M

Remote sensing technology for evapotranspiration in the Great Plains is analyzed and is used for identification of main areas needing additional research: location and extent of vegetated and nonvegetated surfaces, surface temperature, net radiation, and distribution and amount of soil water. The capabilities of present and future aerospace vehicles are surveyed for instrumentation suitable for evapotranspiration remote sensing. A plant resistance model, a bare soil model, and a mixed plant-soil model are examined for the range in surface minus bulk air temperature expected as function of ambient vapor pressure, surface roughness, air temperature, and wind speed. It is concluded that remote sensors can be used with ground measurements to gather regional evapotranspiration data.

Author

N71-29233*# California Univ., Berkeley. Forestry Remote Sensing Lab.
THE APPLICATION OF HIGH ALTITUDE PHOTOGRAPHY FOR VEGETATION RESOURCE INVENTORIES IN SOUTHEASTERN ARIZONA Final Report
Lawrence R. Pettinger, Charles E. Poulton (Oregon State Univ.) et al 31 Dec. 1970 153 p refs
(Contract NAS9-9577)
(NASA-CR-115056) Avail: NTIS CSCL 14E

The potential usefulness of Apollo 9 space photography and sequential high altitude NASA aircraft photography for evaluating natural and cultural resources in southeastern Arizona are reported. Techniques for estimating agricultural crop acreage were developed

for Maricopa County, an area containing over 500,000 acres of cropland. Major aspects of the study included: collection and use of accurate ground data; determination of the optimum film-filter combination and photo dates for identifying particular crops; performance of photointerpretation over a large geographic area; adjustment of survey estimates; and evaluation of survey results in light of user requirements. In addition, a descriptive legend system is detailed for mapping native vegetation, macrorelief and landforms. The application of this legend system has resulted in the preparation of a map of "Natural Vegetation Resources, Agricultural and Urban Land Use" of a large portion of Maricopa County, Arizona. A copy of this map is included.

Author

N71-30175*# National Aeronautics and Space Administration, Washington, D.C.
CORN BLIGHT WATCH EXPERIMENT
20 Jul. 1971 45 p
(NASA-News-Release-71-129) Avail: NASA Scientific and Technical Information Facility, P. O. Box 33, College Park, Md. 20740 CSCL 02C

The 1971 NASA, USDA, and Corn Belt States ground and air study of southern corn leaf blight is summarized. The surveillance aircraft and equipment are described as well as the ground based equipment. Operational and data reduction procedures are included for Illinois, Indiana, Iowa, Minnesota, Missouri, Nebraska, and Ohio.

J.M.

N71-31478# Department of Agriculture, Washington, D.C. Agricultural Stabilization and Conservation Service.
ASCS AERIAL PHOTOGRAPHY STATUS MAPS
31 Jul. 1970 70 p
Avail: NTIS

A compilation of maps of agriculture, forest, and soil conservation service in the U.S. to determine the status of aerial photographic coverage is given.

E.H.W.

N71-32816*# California Univ., Berkeley. Forestry Remote Sensing Lab.
REMOTE SENSING APPLICATIONS IN FORESTRY: CALIBRATION OF COLOR AERIAL PHOTOGRAPHY
Robert W. Dana (Pacific Southwest Forest and Range Expt. Sta.)
30 Jun. 1971 18 p refs Prepared in cooperation with Pacific Southwest Forest and Range Expt. Sta.
(NASA Order W-12898)
(NASA-CR-121372) Avail: NTIS CSCL 14E

The need for a calibration program beginning with an in-house capability for sensitometry is explained in terms of a forestry research unit which employs color aerial photography. An inexpensive, good quality sensitometer is described. Considerations of the system spectral balance in the visible and photographic infrared regions are made with special reference to the properties of the attenuating wedge. Modifications in the effective exposure time of the instrument are described. A test of the effects of chemical strength on film calibration was performed for color film processed in Nikor reels. It exemplifies the need for sensitometry with every processing run to insure precise calibration.

Author

N71-32898*# California Univ., Berkeley. Space Sciences Lab.
AN INTEGRATED STUDY OF EARTH RESOURCES IN THE STATE OF CALIFORNIA USING REMOTE SENSING TECHNIQUES Annual Progress Report
Robert N. Colwell, C. West Churchman, Robert Burgy (Calif. Univ., Davis), Gene Thorley, Gerald Schubert (Calif. Univ., Los Angeles)

et al 1 May 1971 262 p refs

(Grant NGL-05-003-404)

(NASA-CR-121370) Avail: NTIS CSCL 08D

Recent developments in making remote sensing inventories and socio-economic studies related to earth resources are discussed, emphasizing the California Water Project. Some of the complex socio-economic factors involved in the water project are identified as potential users of future water resources with consideration of their attitudes, prejudices, and needs for information; and potential managers of water resources with consideration of their informational requirements in terms of format, frequency, rapidity, and accuracy. The parameters are defined that govern the yield of water, the surface and subsurface flow of water, and the consumption of the water by plants and animals. Problem areas in measuring hydrologic resource parameters through remote sensing in the Feather River headwaters are described in detail. Examples of the dynamics of earth resource management in California and elsewhere are provided. These include monitoring compliance to laws governing sewage disposal and industrial waste discharge, pollution and eutrophication in lakes and streams, and industrial development and the resultant change in land use and environment.

N.E.N.

N71-33808* Biospherics, Inc., Rockville, Md.

SOIL MOISTURE GROUND TRUTH DATA FOR CORRELATION WITH MICROWAVE RADIATION DATA Final Report

Obadiah P. Cohen 4 Apr. 1971 44 p

(Contract NAS5-21610)

(NASA-CR-121439) Avail: NTIS CSCL 08E

Flights over the Imperial Valley and over the Phoenix, Arizona area were conducted on February 25, 1971 and March 1, 1971. In conjunction with these flights, soil moisture samplings of various fields below the flight paths in each area for future correlation with microwave radiation temperatures were conducted. Author

N71-34305* Purdue Univ., Lafayette, Ind. Lab. of Agricultural Remote Sensing.

REMOTE MULTISPECTRAL SENSING IN AGRICULTURE, VOLUME 1, NO. 4

[1971] 150 p Original Contains Color Illustrations

(NASA Order W-12996)

(NASA-CR-121769) Avail: NTIS CSCL 02C

Developments in the detection, identification, and mapping of various vegetation and soil features utilizing multispectral scanner systems and automatic data handling and processing techniques are summarized. The concept, design, calibration, and operation of instruments for the remote measurement of observable physical agricultural features are reported. Data processing methods for multispectral remote sensing in agriculture and agricultural requirements and potential applications of remote sensing are included as well as the plans for agricultural experiments in earth resources aerospace programs. J.M.

N71-34375* California Univ., Riverside. Dept. of Geography. **A SYSTEM OF REGIONAL AGRICULTURAL LAND USE MAPPING TESTED AGAINST SMALL SCALE APOLLO 9 COLOR INFRARED PHOTOGRAPHY OF THE IMPERIAL VALLEY (CALIFORNIA) Final Report**

Claude W. Johnson, Leonard W. Bowden, and Robert W. Pease Nov. 1969 104 p refs Prepared for Geological Survey

(NASA Order W-12570; DI-14-08-0001-10674)

(NASA-CR-121875; USGS-183; USGS-DO-71-009) Avail: NTIS CSCL 14E

Interpretation results of the small scale CIR photography of the Imperial Valley (California) taken on March 12, 1969 by the

Apollo 9 earth orbiting satellite show that world wide agricultural land use mapping can be accomplished from satellite CIR imagery if sufficient a priori information is available for the region being mapped. Correlation of results with actual data is encouraging although the accuracy of identification of specific crops from the single image is poor. The poor results can be partly attributed to only one image taken during mid-season when the three major crops were reflecting approximately the same and their CIR image appears to indicate the same crop type. However, some incapacity can be attributed to lack of understanding of the subtle variations of visual and infrared color reflectance of vegetation and surrounding environment. Analysis of integrated color variations of the vegetation and background environment recorded on CIR imagery is discussed. Author

N71-34400* Fort Collins, Colo.

COLOR AERIAL PHOTOGRAPHY: A NEW VIEW FOR RANGE MANAGEMENT

Richard S. Driscoll Mar. 1971 15 p refs

(PB-199220; FSRP-RM-67) Avail: NTIS CSCL 02F

Shrubs such as antelope bitterbrush, big sagebrush, snowberry, and true mountain-mahogany can be identified more consistently on large-scale (1:600-1:1,200) color infrared aerial photographs than on the same scale color aerial photographs. Identification of relatively large forbs, including Fremont geranium and orange sneezeweed, is also easier on large scale color infrared. Neither film type appeared to give improved information regarding site delineation on smaller scale photographs. Other features of the range environment, including rodent disturbances, can best be identified on color infrared at photo scales up to 1:2,400. All of this depends on obtaining photographs at the right time of year in respect to phenology of the vegetation. Author (GRA)

N71-36770* California Univ., Berkeley. Forestry Remote Sensing Lab.

REMOTE SENSING APPLICATIONS IN FORESTRY. THE DEVELOPMENT OF AN EARTH RESOURCES INFORMATION SYSTEM USING AERIAL PHOTOGRAPHS AND DIGITAL COMPUTERS PHOTOGRAPHS AND DIGITAL COMPUTERS Annual Progress Report

Philip G. Langley, Jan Van Roessel, David A. Sharpnack, and Robert M. Russel 30 Sep. 1970 33 p refs Sponsored in part by Dept. of Agr.

(NASA Order W-12996)

(NASA-CR-122922) Avail: NTIS CSCL 14B

Work continued: (1) to develop an operating earth resources information system oriented toward wildland application; (2) to provide techniques for scanning and interpreting aerial photographs automatically to provide inputs to the information system; and (3) to develop sampling designs which optimally utilize the information system and supplementary remote sensor and ground data for resource inventory and analysis. A systems analysis has been completed specifying the equipment and software packages needed to build the wildland information system and programs have been written for data input. Several image matching procedures for automatic mapping of forest resources using digitized stereopairs of aerial photographs have been tested. A program package for simulating scanned aerial photographs in various orientations has been written. Development of a linear discriminate function (LDF) to automatically classify forest types on panchromatic prints continued. A large scale test of a five-stage forest inventory procedure using Apollo 9 and aerial photographs was conducted on 10 million acres with a sampling error of only 13 percent on an estimate of 2.2 billion cubic feet of timber growing on 5 million acres. Author

N71-37947* California Univ., Berkeley. Forestry Remote Sensing Lab.

THE USE OF MULTISPECTRAL SENSING TECHNIQUES TO DETECT PONDEROSA PINE TREES UNDER STRESS

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FROM INSECT OR PATHOGENIC ORGANISMS Annual Progress Report

R. C. Heller, R. C. Aldrich, W. F. Mc Cambridge, F. P. Weber, and S. L. Wert 30 Sep. 1968 51 p refs Prepared in cooperation with Pacific Southwest Forest and Range Expt. Sta. (NASA Order W-12996)
(NASA-CR-122647) Avail: NTIS CSCL 14B

Airborne sensors to detect and map the presence of dying conifers before visual symptoms occur, and, the smallest scale of aerial photography that may be used to detect insect epidemics from space altitudes are discussed. A pilot test was conducted on a three-square-mile area to simulate conditions expected from space photography. Color and infrared color transparencies were produced at the following scales: 1:116,000, 1:63,360, 1:31,680, 1:15,840, and 1:7,920. Photo interpretation of large-scale transparencies (1:1,584) showed best results when foliage was most discolored in August. Author

N72-12266*# Long Island Univ., Greenvale, N.Y. RELATIONSHIP BETWEEN VEGETATION REFLECTANCE SPECTRA AND SOIL GEOCHEMISTRY: NEW DATA FROM CATHEART MOUNTAIN, MAINE

F. C. Canney (Geol. Survey, Denver, Colo.), Sondra Wenderoth, and Edward Yost /n NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 9 p

Avail: NTIS CSCL 08G

Spectral reflectance curves for red spruce and balsam fir in the 350- to 1100-nanometer region showed differences between specimens growing over and away from a concealed copper deposit at Catheart Mountain, Maine. A sample group of 15 anomalous spruce, 9 background spruce, 10 anomalous fir, and 10 background fir was studied. Measurements of copper and molybdenum contents in the supporting soil were used to categorize the trees as anomalous or background. Analyses using parametric and nonparametric statistical tests were performed to establish whether significant differences existed between the anomalous and background groups. At the 95% confidence level, significant differences were found to exist for both species, generally in the chlorophyll band centered at about 550 nanometers and in the region from 700 to 900 nanometers. Author

N72-12273*# Agricultural Research Service, Weslaco, Tex. AERIAL PHOTOGRAPHY FOR SENSING PLANT ANOMALIES

H. W. Gausman, R. Cardenas, and W. G. Hart /n NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 15 p refs

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 02C

Changes in the red tonal response of Kodak Ektrachrome Infrared Aero 8443 film (EIR) are often incorrectly attributed solely to variations in infrared light reflectance of plant leaves, when the primary influence is a difference in visible light reflectance induced by varying chlorophyll contents. Comparisons are made among aerial photographic images of high- and low-chlorophyll foliage. New growth, foot rot, and boron and chloride nutrient toxicities produce low-chlorophyll foliage, and EIR transparency images of light red or white compared with dark-red images of high-chlorophyll foliage. Deposits of the sooty mold fungus that subsists on the honeydew produced by brown soft scale insects, obscure the citrus leaves' green color. Infected trees appear as black images on EIR film transparencies compared with red images of healthy trees. Author

N72-12274*# South Dakota State Univ., Brookings. Dept. of Plant Science.

REMOTE SENSING FOR DETECTION OF SOIL LIMITATIONS IN AGRICULTURAL AREAS

C. J. Frazee, R. D. Heil, and F. C. Westin /n NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev.,

Vol. 2 1970 23 p

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 08M

Automatic analysis of soil limitations studied by an automatic color TV density slicing system was accomplished. This system color codes the density range of the value component of color of an image. Maps of soil limitations or other similar soil groups are produced by photographing the color coded representation of an area. The planimeter feature of the density slicing system measures the area of each soil limitation providing information on the importance of a soil limitation in an area. The results of this study suggest that an automatic color TV density slicing system has great potential not only for identifying and mapping similar soil areas, but also for indicating the percentage composition of an area. Author

N72-12275*# South Dakota State Univ., Brookings. Remote Sensing Inst.

RECOGNITION OF CROPS AND SOILS BY SPOT DENSITY MEASUREMENTS OF IMAGERY

Gerald D. Nelson /n NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 34 p refs

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 02C

Computerized techniques and methods were used to conduct preliminary soil and crop identification experiments. The soil identification experiment was conducted by making densitometer measurements on Ektachrome infrared film exposed at 14,000 feet. The density measurements were analyzed by plotting sample probability density functions, two-dimensional scatter plots, and the use of K-class I to determine the complete set of classification results for one, two, three and four features. Due to the presence of nineteen classes, crop identification experiments were more difficult to formulate. Classes of corn, fallow, harvested wheat, roadways, trees and water were classified 75 percent correct. Author

N72-12276*# Agricultural Research Service, Weslaco, Tex. Soil and Water Conservation Research Div.

THERMAL SCANNER DATA FOR STUDYING FREEZE CONDITIONS AND FOR AIDING IRRIGATION SCHEDULING

Jon F. Bartholic, Craig L. Wiegand, Ross W. Leamer, and Leo N. Namken /n NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 23 p refs

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 02C

The use of thermal imagery in connection with plant water stress appears to hold considerable potential, particularly with scanners such as the RS-14 where internal calibration sources can be adjusted to bracket the temperatures of interest. The data from the thermal film are fairly easy to reduce; however, data reduction in 3 days or less would be required before it could be used in irrigation timing. Author

N72-12278*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

THE APPLICATIONS OF REMOTE SENSING TO CORN BLIGHT DETECTION AND CROP YIELD FORECASTING

R. B. MacDonald /n NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 35 p

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 02C

Photography revealed the widespread and variable effects of southern corn leaf blight in Indiana. Three levels of severity of the infection could be discerned from good quality color and color infrared photography. As many as five severity levels appeared to be detectable and classifiable with multispectral scanner data and pattern recognition analysis. These conclusions are preliminary in nature, however, having been obtained from a limited amount of good quality scanner data collected over a small geographic area. Author

N72-12279* California Univ., Berkeley. Forestry Remote Sensing Lab.

A SEMI-OPERATIONAL AGRICULTURAL INVENTORY USING SMALL SCALE AERIAL PHOTOGRAPHY

William C. Draeger and Lawrence R. Pettinger *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 28 p refs

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 02C

The feasibility of performing inventories of agricultural resources using very small scale aerial or space photography was studied. The results were encouraging on two counts: (1) The very practical problems of an operational survey are being faced and solutions are being found. (2) It seems that a fully operational agricultural inventory using space photography is not beyond the scope of present technology. Author

N72-12280* California Univ., Berkeley. Forestry Remote Sensing Lab.

IMAGE RESOLUTION: ITS SIGNIFICANCE IN A WILDLAND AREA

Donald T. Lauer and Randolph R. Thaman *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 24 p

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 08F

The information content of simulated space photos as a function of various levels of image resolution was determined by identifying major vegetation-terrain types in a series of images purposely degraded optically to different levels of ground resolution resolvable distance. Comparison of cumulative interpretation results with actual ground truth data indicates that although there is definite decrease in interpretability as ground resolvable distance increases, some valuable information is gained by using even the poorest aerial photography. Developed is the importance of shape and texture for correct identification of broadleaf or coniferous vegetation types and the relative unimportance of shape and texture for the recognition of grassland, water bodies, and nonvegetated areas. Imagery must have a ground resolvable distance of at least 50 feet to correctly discriminate between primary types of woody vegetation. G.G.

N72-12281* Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.

IDENTIFICATION AND MEASUREMENT OF SHRUB TYPE VEGETATION ON LARGE SCALE AERIAL PHOTOGRAPHY

Richard S. Driscoll *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 15 p refs

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 02F

Important range-shrub species were identified at acceptable levels of accuracy on large-scale 70 mm color and color infrared aerial photographs. Identification of individual shrubs was significantly higher, however, on color infrared. Photoscales smaller than 1:2400 had limited value except for mature individuals of relatively tall species, and then only if crown margins did not overlap and sharp contrast was evident between the species and background. Larger scale photos were required for low-growing species in dense stands. The crown cover for individual species was estimated from the aerial photos either with a measuring magnifier or a projected-scale micrometer. These crown cover measurements provide techniques for earth-resource analyses when used in conjunction with space and high-altitude remotely procured photos. Author

N72-12282* Oregon State Univ., Corvallis. Dept. of Range Management.

A VEGETATIONAL AND ECOLOGICAL RESOURCE ANALYSIS FROM SPACE AND HIGH FLIGHT PHOTOGRAPHY

Charles E. Poulton, David P. Faulkner, and Barry J. Schrupf *In*

NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 14 p refs

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 02C

A hierarchical classification of vegetation and related resources is considered that is applicable to convert remote sensing data in space and aerial synoptic photography. The numerical symbolization provides for three levels of vegetation classification and three levels of classification of environmental features associated with each vegetational class. It is shown that synoptic space photography accurately projects how urban sprawl affects agricultural land use areas and ecological resources. G.G.

N72-12283* Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.

REMOTE DETECTION OF INSECT EPIDEMICS IN CONIFERS

Robert C. Heller *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 36 p refs

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 02F

With properly exposed color or infrared color film, discolored foliage caused by insect infestations in ponderosa pine is detectable on moderately small-scale photographs with acceptable accuracies. Black and white photographs which matched the wavebands of the ERTS multispectral scanner were combined into one additive color photo. This imagery was not as useful as photographs taken on color, color infrared, or color film with a minus blue filter. Based on the high-altitude color and color infrared photos obtained, it is concluded that only insect infestations larger than 100 meters in diameter are detectable on ERTS imagery. Author

N72-12284* Michigan Univ., Ann Arbor. School of Natural Resources.

MULTISPECTRAL SENSING OF MOISTURE STRESS

Charles E. Olson, Jr. *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 18 p refs

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 02F

Laboratory reflectance data, and field tests with multispectral remote sensors provide support for this hypotheses that differences in moisture content and water deficits are closely related to foliar reflectance from woody plants. When these relationships are taken into account, automatic recognition techniques become more powerful than when they are ignored. Evidence is increasing that moisture relationships inside plant foliage are much more closely related to foliar reflectance characteristics than are external variables such as soil moisture, wind, and air temperature. Short term changes in water deficits seem to have little influence on foliar reflectance, however. This is in distinct contrast to significant short-term changes in foliar emittance from the same plants with changing wind, air temperature, incident radiation, or water deficit conditions. Author

N72-12285* Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.

CLASSIFYING FOREST AND NONFOREST LAND ON SPACE PHOTOGRAPHS

Robert C. Aldrich *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 37 p refs

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 02F

Although the research reported is in its preliminary stages, results show that: (1) infrared color film is the best single multiband sensor available; (2) there is a good possibility that forest can be separated from all nonforest land uses by microimage evaluation techniques on IR color film coupled with B/W infrared and panchromatic films; and (3) discrimination of

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forest and nonforest classes is possible by either of two methods: interpreters with appropriate viewing and mapping instruments; or programmable automatic scanning microdensitometers and automatic data processing. Author

N72-12291*# Kansas Univ./Center for Research, Inc., Lawrence. RECENT ADVANCES IN RADAR APPLICATIONS TO AGRICULTURE

Stanley A. Morain In NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 27 p refs

(Contract NAS9-10261)

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 171

A series of remote radar sensing studies are summarized. These efforts comprise geoscience interpretations of such complex phenomena as those manifested in agricultural patterns. Considered are basic remote sensing needs in agriculture and the design and implementation of radar keys in the active microwave region as well as fine resolution radar imagery techniques for agriculture determinations and soil mapping. G.G.

N72-12298*# South Dakota State Univ., Brookings. Remote Sensing Inst. SUMMARY: REMOTE SENSING SOIL MOISTURE RESEARCH

Fred A. Schmer, Hal D. Werner, and Fred A. Waltz In NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 9 p

Avail: NTIS HC \$6.00/MF \$0.95 CSCL 08M

During the 1969 and 1970 growing seasons research was conducted to investigate the relationship between remote sensing imagery and soil moisture. The research was accomplished under two completely different conditions: (1) cultivated cropland in east central South Dakota, and (2) rangeland in western South Dakota. Aerial and ground truth data are being studied and correlated in order to evaluate the moisture supply and water use. Results show that remote sensing is a feasible method for monitoring soil moisture. Author

N72-12299*# Geological Survey, Tucson, Ariz. MEASUREMENT OF PLANT COMMUNITY COVER FROM AERIAL PHOTOGRAPHS USING EKTACHROME INFRARED AERO FILM

Raymond M. Turner In NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 8 p refs Sponsored by NASA

Avail: NTIS HC \$6.00/MF \$0.95 CSCL 14E

Color-IR aerial photographs of arid-zone vegetation have been used to estimate the amount of green plant material on the ground. The purpose has been to estimate plant cover as it varies with time and space and relate this vegetative measure to hydrologic conditions. Aerial photographs of the 6000-acre target area were taken periodically over a period of 3 years. Results of densitometric analyses are presented. Author

N72-12361# California Univ., Riverside. Dept. of Geography. REMOTE SENSING OF CHAPARRAL FIRE POTENTIAL: CASE STUDY IN TOPANGA CANYON, CALIFORNIA

Austin E. Sullivan and William G. Brooner Mar. 1971 53 p refs

(Contract N00014-69-A-0200-5001)

(AD-725862; TR-T-71-1; Task-NR-387-047) Avail: NTIS CSCL 13/12

Urban expansion into areas of chaparral vegetation has greatly increased the danger of wildland fires in settled areas, particularly in southern California. Fires in Topanga Canyon, for

example, have been especially severe. Reliable methods of predicting the potential hazard for chaparral fires to man and his settlements in such areas are needed. Aerial photography, using color infrared film, was examined to determine potential fire hazard in Topanga Canyon, and maps indicating potential fire hazard were constructed. A subsequent field survey verified the accuracy of these maps, though the failure to obtain stereoscopic coverage of the study area resulted in a general underestimation of slope as a factor in fire hazard analysis. Remote sensing techniques, especially the use of color infrared aerial photography, provide a useful tool for fire hazard analysis, including interpretive information about fuel volumes, physiognomic plant groupings, the relationships of buildings to both natural and planted vegetation, and fire vulnerability of roofing materials. In addition, the behavior of the September, 1970 Wright Fire in the Topanga study area suggested the validity of the fire potential analysis which had been made prior to that conflagration. Author (GRA)

N72-14336 Department of Energy, Mines and Resources, Ottawa (Ontario).

RESOURCE SATELLITES AND REMOTE AIRBORNE SENSING FOR CANADA. REPORT NO. 6: FORESTRY AND WILDLANDS

Dennis White, ed. 1971 23 p

(M75-2/5) Copyright. Avail: Issuing Activity

The disciplines of forestry, ecology, wildlife science and related aspects of soil and land studies are discussed. The benefits derived through application of remote-sensing techniques in these fields are investigated. Users in these disciplines are relatively well informed about traditional air photography and its application to forestry and wildland programs. Large, operational, air-photographic projects have been undertaken by Federal, provincial and industrial agencies. Remote-sensing research is active and tends to be concentrated in Federal agencies, some universities and the larger, provincial, forest-inventory organizations. Nevertheless much further research is required to test new techniques in remote sensing and data interpretation, and to evaluate the potential of sensors in the non-visible ranges of the spectrum. Author

N72-14364# Department of Energy, Mines and Resources, Ottawa (Ontario).

RESOURCE SATELLITES AND REMOTE AIRBORNE SENSING FOR CANADA. REPORT NO. 2: AGRICULTURE AND GEOGRAPHY

Dennis White, ed. 1971 34 p

(M75-2/2) Avail: NTIS

The recommendations of the Working Group on Agriculture and Geography concerning remote sensing in programs related to Canada's resources and environment are presented. The recommendations are that Canada should take advantage of the NASA ERTS project by establishing a station in Canada to receive the data. A national committee on remote sensing is required to facilitate the development of services, and to coordinate activities in program development, data dissemination, research programs, and training. F.O.S.

N72-16093# Physics Lab. RVO-TNO, The Hague (Netherlands). THE RADAR BACKSCATTER OF VEGETATION

G. P. deLoor and A. A. Jurrieens In AGARD Propagation Limitations in Remote Sensing Oct. 1971 7 p refs

Avail: NTIS HC \$6.00/MF \$0.95

To study the possible use of image tone in SLAR imagery for inventory purposes, a series of measurements were performed at X-band (and some at Ka-band) on the backscatter coefficients of single fields in an agricultural area through a complete growing season. Use was made of a stable platform with the radar at an altitude of 75 m above the terrain. The influence of

the weather on the backscatter coefficient is studied by comparing the measurements with the output of an automatic weather station. Author

N72-18335*# California Univ., Berkeley.
ANALYSIS OF AGRICULTURAL RESOURCES IN THE IMPERIAL VALLEY, CALIFORNIA
 Randolph R. Thaman and Leslie W. Senger *In its* Monitoring Earth Resources from Aircraft and Spacecraft 1971 p 85-92 refs Original contains color illustrations
 Avail: NTIS; SOD \$4.00 CSCL 02D

Differentiating individual crops within an agricultural area, based on high altitude and Apollo 9 photography, is discussed. The Imperial Valley, California area was used for the study. The primary objective of the program was to determine the feasibility of making broad crop inventories based on such photography. Results indicate spacecraft photographs can be used but are less accurate than high altitude photographs because of poor color and tonal differences. High altitude photography has the disadvantage of being dependent on weather conditions for its success. E.H.W.

N72-18337*# California Univ., Berkeley.
EVALUATION OF WILDLAND RESOURCES OF THE NASA BUCKS LAKE TEST SITE
 Andrew S. Benson *In its* Monitoring Earth Resources from Aircraft and Spacecraft 1971 p 111-115 refs Original contains color illustrations
 Avail: NTIS; SOD \$4.00 CSCL 08G

Three types of high altitude photography, Infrared Ektachrome, Infrared Aerographic with Wratten 89B filter (IR-89B), and Panatomic-X with a Wratten 25A filter (Pan-25A), were used to analyze wildland resources around Buck's Lake test site. Based on these data efforts were made to (1) map types of ground cover according to brush or dry-site wood, medium to high density conifer, low density conifer, rock or bare soil, meadow or riparian hardwood, and water; (2) monitor changes in ground cover with sequential coverage; and (3) select primary sample units for more detailed multistage sampling. Results show Infrared Ektachrome to be most satisfactory for determining ground cover boundaries, while Pan-25A was satisfactory for determining other cover types. Except for determining bodies of water, water courses, and riparian hardwoods, IR-89B proved unsatisfactory for overall ground cover typing. It was concluded that more study is needed before the usefulness of high altitude photography as an inventory procedure of wildland resources can be assessed. E.H.W.

N72-18340*# California Univ., Berkeley.
THE USE OF SMALL-SCALE AERIAL PHOTOGRAPHY IN A REGIONAL AGRICULTURAL SURVEY
 William C. Draeger and A. S. Benson *In its* Monitoring Earth Resources from Aircraft and Spacecraft 1971 p 143-149 refs
 Avail: NTIS; SOD \$4.00 CSCL 14E

Photointerpretation tests of barley and wheat around Maricopa County, Arizona are made to: (1) determine the relative value of small scale aerial photography and Apollo 9 space photography for crop inventory, and (2) evaluate the usefulness of multistage and multiband photography of such surveys. Survey results are given in tabular form. E.H.W.

N72-18354*# Georgia Univ., Athens.
VEGETATION CHANGES CAUSED BY FIRE IN THE FLORIDA FLATWOODS AS OBSERVED BY REMOTE SENSING

W. T. Meador, Jr. and Merle C. Prunty, Jr. Jun. 1969 15 p refs Original contains color illustrations
 (NASA Order R-09-020-024; Contract DI-14-08-0001-11251)
 (NASA-CR-125649; USGS-IR-NASA-148) Avail: NTIS CSCL 02F

The nature of the flatwoods and the role that ground fires have played in maintaining them are discussed. Emphasis is placed on the areal and temporal extent of burns as recorded uniformly by remote sensors. Thermal infrared, color infrared, and Ektachrome imagery were obtained from sensors flown by a NASA aircraft at 15,000 feet over a test site in Osceola County, Florida, in March 1968. The overall pattern of burning can be sequenced and mapped uniformly from the imagery. By comparing the various imagery, areal and temporal extent of burned areas can be determined. It was concluded that remote sensed imagery provides more accurate and areally comprehensive media for assessing the impact of ground fires on the landscape of the flatwoods region than are available from any other data source. Author

N72-18357*# Oregon State Univ., Corvallis.
THE EMPLOYMENT OF WEATHER SATELLITE IMAGERY IN AN EFFORT TO IDENTIFY AND LOCATE THE FOREST-TUNDRA ECOTONE IN CANADA
 Susan A. Aldrich, Frank T. Aldrich, and Robert D. Rudd Nov. 1969 45 p refs
 (NASA Order W-12589; Contract DI-160-75-01-32-10)
 (NASA-CR-125647; USGS-IR-NASA-169) Avail: NTIS CSCL 08G

Weather satellite imagery provides the only routinely available orbital imagery depicting the high latitudes. Although resolution is low on this imagery, it is believed that a major natural feature, notably linear in expression, should be mappable on it. The transition zone from forest to tundra, the ecotone, is such a feature. Locational correlation is herein established between a linear signature on the imagery and several ground truth positions of the ecotone in Canada. Author

N72-20400*# Translation Consultants, Ltd., Arlington, Va.
DISTANT-READING SOIL THERMOMETER
 Ye. M. Grossman and A. V. Gudimenko Washington NASA Apr. 1972 6 p refs Transl. into ENGLISH from Meteorol., Klimatol. i Gidrol. (Kiev), no. 4, 1969 p 53-58
 (Contract NASw-2038)
 (NASA-TT-F-14161) Avail: NTIS CSCL 14B

The design and operation of the electric thermometer is described. The instrument possesses the following advantages: a high degree of accuracy (0.2 C) reliability, stability of parameters under long operation, and standardized sensors. Comparable continued operation of the instrument in natural field conditions provided gaged data for those measurements made by means of standard meteorological soil thermometers. Author

N72-21358*# Texas A&M Univ., College Station. Remote Sensing Center.
A COMPARISON OF TWO APPROACHES FOR CATEGORY IDENTIFICATION AND CLASSIFICATION ANALYSIS FROM AN AGRICULTURAL SCENE
 J. A. Schell Mar. 1972 32 p refs Presented at the Space Inst. Conf. on Earth Resources Observations and Inform. Analysis Systems, Tenn. Univ., 1972
 (Grant NGL-44-001-001)
 (NASA-CR-126024; RSC-36) Avail: NTIS CSCL 08G

Supervised and unsupervised classification modes are discussed in light of the multidisciplinary, high data rate requirements of the ERTS satellites soon to be launched. Inadequacies of each system in light of these requirements are noted and a compromise solution to the data classification system is proposed. An example of results obtained with an implementation of this system are shown and compared with results from a supervised classification scheme. Author

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N72-21458# Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.

THE FEASIBILITY OF USING COLOR AERIAL PHOTOGRAPHY TO DETECT AND EVALUATE SULPHUR DIOXIDE INJURY TO TIMBER STANDS

Kristina A. Zealer, Robert C. Haller, Nancy X. Norick, and Marilyn Wilkes Nov. 1971 160 p refs
(PB-205279; APTD-0865) Avail: NTIS CSCL 08F

A feasibility study was undertaken near a point source of sulphur dioxide, emissions to determine the best film-filter-scale combination of aerial photography to evaluate SO₂ injury to forest vegetation. Normal color film, exposed through a didymium filter, at very large scales (1:800 and 1:1,584) proved to be the most accurate sensor. Color infrared film was almost as good. Interpreter differences were least at large scale and on color film. Ground variables which were best correlated with photo interpretation were: crown color, needle color, Munsell hue, percent of current needles with tip dieback and the length of the tip dieback. A combination of photo and ground plots appears to be the most efficient design for measuring these effects-especially, if done over large areas. GFA

N72-22370*# Virginia Polytechnic Inst., Blacksburg. Research Div.

REMOTE SENSING IN VIRGINIA AGRICULTURE

D. E. Pettry, M. E. Newhouse, E. M. Dunton, Jr., and J. H. Scott, Jr. [1972] 7 p refs Original contains color illustrations
(Contract NAS6-1863)

(NASA-CR-62080; Rept-71) Avail: NTIS CSCL 02B

An experimental investigation, designed to develop and evaluate multispectral sensing techniques used in sensing agricultural crops, is described. Initial studies were designed to detect plant species and associated diseases, soil variations, and cultural practices under natural environment conditions. In addition, crop varieties, age, spacing, plant height, percentage of ground cover, and plant vigor are determined. Author

N72-23293 Department of Agriculture, Washington, D.C. Research Management Group.

USER NEEDS IN AGRICULTURE AND FORESTRY

A. B. Park In Princeton Univ. Proc. of the Princeton Univ. Conf. on Aerospace Methods for Revealing and Evaluating Earth's Resources Jun. 1970 26 p
Copyright. Avail: Issuing Activity

The uses which will be made of spacecraft data by the various services of the Department of Agriculture are described, and the coverage requirements are listed for the individual services. These requirements are for soil, crop, and tree identification, water detection, land use, and surveillance activities. Camera and scanner data in infrared and visible regions are requested, and reasons for emphasizing the visible region are given. Experiments with different films and automatic mapping, and with different automatic processing techniques are described. N.E.N.

N72-23299 General Electric Co., Philadelphia, Pa. Missile and Space Div.

AGRICULTURAL RESOURCE INFORMATION REQUIREMENTS OF NONGOVERNMENTAL USERS

Harold G. Lorsch In Princeton Univ. Proc. of the Princeton Univ. Conf. on Aerospace Methods for Revealing and Evaluating Earth's Resources Jun. 1970 17 p ref

Copyright. Avail: Issuing Activity

A survey was performed to obtain information on which to base a preliminary design for an aircraft/spacecraft-assisted agricultural resource information system for nongovernmental users. It was found that remote sensing can satisfy many needs of the agribusiness community for information. Nongovernmental

user information requirements are of greater variety than governmental requirements. The readiness to use remotely sensed information increases with the increase in the size of a user organization and its experience in electronic data processing. The preliminary survey showed that interviews are effective in identifying information requirements of agribusiness users.

Author

N72-23300 Princeton Univ., N.J. Woodrow Wilson School. MANAGEMENT OF GRAZING LANDS BY EARTH RESOURCES SATELLITES

Charles R. Frank, Jr. In its Proc. of the Princeton Univ. Conf. on Aerospace Methods for Revealing and Evaluating Earth's Resources Jun. 1970 6 p
Copyright. Avail: Issuing Activity

The benefits of a satellite-assisted program for grazing land management are estimated, with particular reference to the needs of the Bureau of Land Management of the Department of the Interior and the Forest Service of the U.S. Department of Agriculture. The activities of the agencies and the value of the grazing land resource are described. The specific areas in which benefits might accrue are determined to be the use of satellite photographs as a substitute or supplement to aerial photographs, the use of camera images and spectral signatures to monitor deterioration in range conditions and determine the causes of deterioration, and the use of satellite data to provide forecasts of forage production for the individual rancher. The results of the cost benefit analysis indicate that an experimental earth resources satellite program is more than justified. N.E.N.

N72-23313# California Univ., Berkeley. Space Sciences Lab. THE FUTURE FOR REMOTE SENSING OF AGRICULTURAL, FOREST AND RANGE RESOURCES

Robert N. Colwell In Comm. on Sci. and Astronaut. (U.S. House) Remote Sensing of Earth Resources 1972 p 103-117

Avail: SOD \$1.25

Potential users of remote sensing data and their informational requirements are considered. The use of remote sensing in the management of renewable resources, such as crops, forests, and range lands, is discussed. Various factors are presented which are involved in developing operational plans for the remote sensing of renewable resources. K.P.D.

N72-24400* Wisconsin Univ., Madison. Dept. of Civil and Environmental Engineering. SEQUENTIAL AERIAL PHOTOGRAPHY AND IMAGERY FOR SOIL STUDIES

Ralph W. Kiefer Jan. 1972 26 p refs Presented at Symp. on Remote Sensing for Highway Eng., Washington, D. C., Jan. 1972

(Grant NGL-50-002-127)

(NASA-CR-126633; Rept-10) Copyright. Avail: Wis. Univ., Madison, 351 Meteorology and Space Sci. Bldg.: HC \$2.00 CSCL 14E

Color infrared photographs and thermal images from agricultural fields located at the former shoreline of a small glacial lake are presented. The contrast between the silty lakebed soils and a small sandy beach ridge can be clearly seen. The contrast between this beach ridge and the surrounding lakebed soils changes considerably during the year. Based on the preliminary work reported herein, it appears that thermal imagery may prove superior to photography for soil mapping purposes. There should be an optimum time of year and also an optimum time of day for obtaining thermal imagery for soil studies. Author

N72-25029*# Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.

THE DEVELOPMENT OF SPECTRO-SIGNATURE INDICA-

TORS OF ROOT DISEASE Annual Progress Report

John F. Wear 30 Sep. 1968 33 p refs

(NASA Order W-12996)

(NASA-CR-126719) Avail: NTIS HC \$3.75 CSCL 02F

The development and testing of airborne sensors that might be effective in discriminating root rot of infected trees from healthy ones are outlined. The sensing device is composed of a thermal infrared radiometer and an instant replay video scan system.

Author

N72-25327 Tennessee Univ., Knoxville.

REMOTE SENSING OF TERRESTRIAL VEGETATION: A COMPREHENSIVE BIBLIOGRAPHY

Paul F. Krumpke Jan. 1972 72 p refs

Avail: Paul F. Krumpke, Forestry Remote Sensing Lab., Calif. Univ., Berkeley, 94720

A comprehensive bibliography, containing more than 850 references, is presented. The bibliography deals with the utilization and application of remote sensing in forestry, agriculture, and plant ecology, as well as closely allied fields, such as land use planning, resource inventory and management, and soils and terrain analysis. In addition, technical background, historical, and data manipulation and analysis references are included. Author

N72-26279*# Smithsonian Institution, Washington, D.C. AGRICULTURE AND FORESTRY: IDENTIFICATION, VIGOR, AND DISEASE

Dale W. Jenkins In NASA, Washington Remote Sensing of the Chesapeake Bay 1972 p 91-102

Avail: NTIS; SOD \$2.25 CSCL 02F

The agricultural and forestry areas which comprise the watershed of the Chesapeake Bay are described. Major problems of watershed creation and management with emphasis on the erosion problem are discussed. Remote sensing as it relates to the identification of plant species and vigor, pollution, disease, and insect infestation are examined. The application of infrared photography, multispectral sensing, and sequential survey is recommended to identify ecological changes and improve resources management. Author

N72-27351*# Geological Survey, Washington, D.C. FEASIBILITY OF SURVEYING PESTICIDE COVERAGE WITH AIRBORNE FLUOROMETER

George E. Stoertz and William R. Hemphill Apr. 1970 24 p refs

(NASA Order T-90485C)

(NASA-CR-127528; USGS-IR-NASA-184) Avail: NTIS HC \$3.25 CSCL 02D

Response of a Fraunhofer line discriminator (FLD) to varying distributions of granulated corncoats stained with varying concentrations of Rhodamine WT dye was tested on the ground and from an H-19 helicopter. The granules are used as a vehicle for airborne emplacement of poison to control fire ants in the eastern and southeastern United States. Test results showed that the granules are detectable by FLD but that the concentration must be too great to be practical with the present apparatus. Possible methods for enhancement of response may include: (1) increasing dye concentration; (2) incorporating with the poisoned granules a second material to carry the dye alone; (3) use of a more strongly fluorescent substance (at 5890 Å); (4) modifying the time interval after dyeing, or modifying the method of dyeing; (5) modifying the FLD for greater efficiency, increased field of view or larger optics; or (6) experimenting with laser-stimulated fluorescence. Author

N72-27368# South Dakota State Univ., Brookings. Remote Sensing Institute.

REMOTE SENSING FOR EVALUATING FLOOD DAMAGE**CONDITIONS. THE RAPID CITY, SOUTH DAKOTA FLOOD. 9 JUNE 1972, FIELD INVESTIGATION REPORT A report to the Governor of South Dakota**

Victor I. Myers, Fred A. Waltz, and Jack R. Smith Jun. 1972 32 p

(SDSU-RSI-72-11) Avail: NTIS HC \$3.75

Flood-damaged areas in the vicinity of Rapid City, South Dakota were surveyed at 4000 ft above ground level with Ektachrome color and Ektachrome color infrared film (70 mm width), and with thermal infrared. The photos have 60% overlap for stereo viewing. The areas covered included: (1) Rapid Creek, from the headwaters to the Cheyenne River, approximately 70 miles; (2) Box Elder Creek, from 10 miles above Interstate 90 north of Rapid City, downstream to New Underwood, approximately 30 miles; (3) Keystone and downstream, approximately 5 miles; (4) Hill City and vicinity; and (5) the area along the Burlington and Quincy Railroad between Keystone and Hill City, approximately 10 miles. Author

N72-27981# Joint Publications Research Service, Arlington, Va. TRANSLATIONS ON EASTERN EUROPE - SCIENTIFIC AFFAIRS, NO. 254

5 Jul. 1972 70 p refs Transl. into ENGLISH from Eastern European reports

(JPRS-56426) Avail: NTIS HC \$5.50

Forest density in Romania was determined from aerial photographs and the results were compared to ground-based measurements with a Moosehorn instrument based on punctiform sampling. The black and white photographs were taken on panchromatic film scales between 1:9000 and 1:12,000. The interpretation conditions involved contact copy photographs and mirror stereoscopes. It is felt that good density measurements were obtained. Efforts to protect Yugoslavian farm crops against hail are briefly described and include a proposal to use rockets. A long-range Hungarian research plan, influenza epidemic migration in West Germany, and other scientific and technical research are also reported. N.E.N.

N72-28037*# Michigan Univ., Ann Arbor. School of Natural Resources.

REMOTE SENSING OF CHANGES IN MORPHOLOGY AND PHYSIOLOGY OF TREES UNDER STRESS Annual Progress Report

Charles E. Olson, Wayne G. Rohde, and Jennifer M. Ward Berkeley, Calif. Univ. Forestry Remote Sensing Lab. 30 Sep. 1971 84 p refs Prepared for Calif. Univ., Berkeley, Forestry Remote Sensing Lab. in cooperation with Dept. of Agr. Forest Serv.

(NASA Order W-13308)

(NASA-CR-127640; APR-5) Avail: NTIS HC \$6.25 CSCL 02D

Measurements on foliage samples collected from several drought and salt treated plants revealed that leaf thickness decreased with increasing severity of the drought treatment and increased with increasing severity of treatment with NaCl, but remained essentially unaffected by treatment with CaCl₂. Airborne data collected by multispectral scanner indicated that false color images provide selective enhancement of a diseased area. Comparison of simulated and actual aerial color and color IR photography revealed that the color renditions of the MSS simulations agreed closely with those of the actual photography. Author

N72-28045*# Texas Univ., Houston. School of Public Health. [CULEX QUINQUEFASCIATUS BREEDING SITES] Quarterly Report. 3 Apr. - 4 Jul. 1972

4 Jul. 1972 25 p

(Contract NAS9-12696)

(NASA-CR-115708; QR-1) Avail: NTIS HC \$3.25 CSCL 06C

The development of techniques, equipment, and methods for implementing ground truth data on Culex quinquefasciatus breeding sites are outlined. E.H.W.

01 AGRICULTURE AND FORESTRY

N72-28321*# Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.

THE DEVELOPMENT OF SPECTRO-SIGNATURE INDICATORS OF ROOT DISEASE IMPACTS ON FOREST STANDS

Annual Progress Report

F. P. Weber and J. F. Wear 30 Sep. 1970 55 p refs

(NASA Order W12996)

(NASA-CR-127450) Avail: NTIS HC \$4.75 CSCL 02F

A field research program was begun in 1969 and intensified in 1970 on the physiology and biophysical responses of second-growth Douglas fir infected with root rot fungus. A double tramway system was suspended between three 100-foot instrument towers to carry sensors for measuring the energy response from above both healthy and infected trees. Processing and analysis was completed of airborne multispectral scanner imagery collected over the Wind River research area in 1969. Likelihood ratio processing of three-channel infrared data and Euclidean distance analysis of ten-channel spectrometer data did not identify incipient root rot infection outside the training sets. In all cases infected fir was misclassified as healthy fir. It was concluded from careful examination of physiological data that Poria root rot infection has little effect on water metabolism and energy exchange. What was identified was a low-grade stress that affects respiration and metabolism over long periods of time. This led to minor changes in the external physical symptoms of Poria-infected trees which was revealed only in the shortwave reflectance data.

Author

N72-28324*# Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.

MONITORING FOREST LAND FROM HIGH ALTITUDE AND FROM SPACE Annual Progress Report

30 Sep. 1971 180 p refs Prepared in cooperation with Calif. Univ.

(NASA Order W-13308)

(NASA-CR-127702) Avail: NTIS HC \$11.00, CSCL 02F

Forest inventory, forest stress, and standardization and calibration studies are presented. These include microscale photointerpretation of forest and nonforest land classes, multiseasonal film densities for automated forest and nonforest land classification, trend and spread of bark beetle infestations from 1968 through 1971, aerial photography for determining optimum levels of stand density to reduce such infestations, use of airborne spectrometers and multispectral scanners for previsual detection of Ponderosa pine trees under stress from insects and diseases, establishment of an earth resources technology satellite test site in the Black Hills and the identification of natural resolution targets, detection of root disease impact on forest stands by sequential orbital and suborbital multispectral photography, and calibration of color aerial photography. K.P.D.

N72-28325*# Minnesota Univ., Minneapolis. School of Forestry.

REMOTE SENSING OF VIGOR LOSS IN CONIFERS DUE TO DWARF MISTLETOE Annual Progress Report

Merle P. Meyer, D. W. French, Robert P. Latham, Charles A. Nelson, and Robert W. Douglass Berkeley, Calif. Calif. Univ. Forestry Remote Sensing Lab. 30 Sep. 1971 45 p refs Prepared for Calif. Univ., Berkeley. Forestry Remote Sensing Lab. in cooperation with Dept. of Agr. Forest Serv. Original contains color illustrations

(NASA Order R-09-038-002)

(NASA-CR-127682) Avail: NTIS HC \$4.25 CSCL 02F

The initial operation of a multiband/multidate tower-tramway test site in northeastern Minnesota for the development of specifications for subsequent multiband aerial photography of more extensive study areas was completed. Multiband/multidate configurations suggested by the tower-tramway studies were and will be flown with local equipment over the Togo test site. This site was photographed by the NASA RB57F aircraft in August and September 1971. It appears that, of all the film/filter combinations attempted to date (including optical recombining of several spectral band images via photo enhancement techniques), Ektachrome infrared film with a Wratten 12 filter is the best for

detecting dwarf mistletoe, and other tree diseases as well. Using this film/filter combination, infection centers are easily detectable even on the smallest photo scale (1:100,000) obtained on the Togo site.

Author

N72-28326*# Oregon State Univ., Corvallis. Forestry Remote Sensing Lab.

INVENTORY AND ANALYSIS OF NATURAL VEGETATION AND RELATED RESOURCES FROM SPACE AND HIGH ALTITUDE PHOTOGRAPHY Annual Progress Report

Charles E. Poulton, David P. Faulkner, James R. Johnson, David A. Mouat, and Barry J. Schrupf 30 Sep. 1971 59 p refs Prepared in cooperation with the Dept. of Agriculture Original contains color illustrations

(NASA Order R-09-038-002)

(NASA-CR-127697) Avail: NTIS HC \$5.00 CSCL 02F

A high altitude photomosaic resource map of Site 29 was produced which provided an opportunity to test photo interpretation accuracy of natural vegetation resource features when mapped at a small (1:133,400) scale. Helicopter reconnaissance over 144 previously selected test points revealed a highly adequate level of photo interpretation accuracy. In general, the reasons for errors could be accounted for. The same photomosaic resource map enabled construction of interpretive land use overlays. Based on features of the landscape, including natural vegetation types, judgements for land use suitability were made and have been presented for two types of potential land use. These two, agriculture and urbanization, represent potential land use conflicts.

Author

N72-28327*# Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo. Forestry Remote Sensing Lab.

MULTISTAGE, MULTIBAND AND SEQUENTIAL IMAGERY TO IDENTIFY AND QUANTIFY NON-FOREST VEGETATION RESOURCES Annual Progress Report

Richard S. Driscoll 30 Sep. 1971 75 p refs Prepared in cooperation with the Dept. of Agriculture Original contains color illustrations

(NASA Order R-09-038-002)

Avail: NTIS HC \$5.75 CSCL 02B

Analysis and recognition processing of multispectral scanner imagery for plant community classification and interpretations of various film-filter-scale aerial photographs are reported. Data analyses and manuscript preparation of research on microdensitometry for plant community and component identification and remote estimates of biomass are included.

Author

N72-28329*# California Univ., Berkeley. Forestry Remote Sensing Lab.

ANALYSIS OF REMOTE SENSING DATA FOR EVALUATING VEGETATION RESOURCES Annual Progress Report

30 Sep. 1971 204 p refs Prepared in cooperation with Forest Service, Washington, D. C. Original contains color illustrations

(NASA Order W-13308; NASA Order W-13300)

(NASA-CR-127443) Avail: NTIS HC \$12.25 CSCL 02B

Increased utilization studies for current remote sensor and analysis capabilities included: (1) a review of testing procedures for quantifying the accuracy of photointerpretation; (2) field tests of a fully portable spectral data gathering system, both on the ground and from a helicopter; and (3) a comparison of three methods for obtaining ground information necessary for regional agricultural inventories. A version of the LARS point-by-point classification system was upgraded by the addition of routines to analyze spatial data information.

Author

N72-28330# Helsinki Univ. of Technology, Otaniemi (Finland). EFFECT OF WEATHER ON WATER ECONOMY AND CROP YIELDS

Jussi Hooli 1971 247 p refs In FINNISH; ENGLISH summary

Avail: NTIS HC \$14.50

The dependence of crop yields on weather and soil factors in south and southwest Finland where water conservation is practiced was investigated. The study is based on meteorological and agricultural statistics and on data collected at several experimental stations over periods of from 15 to 40 years. Over half of the land consists of drought-sensitive sandy and clay soils. Spring-sown cereals, potatoes, and hay were studied, and precipitation, temperature, relative humidity, and cloud cover were analyzed, along with snow depth and ground frost thickness where hay was harvested. Spring cereal yields were affected by precipitation more in sandy than in clay soils. Rain had practically no effect on yields on peaty soils. It is concluded that differences in yield dependence on precipitation are due to differences in soils and water economy. N.E.N.

SENSING [SURVEILLANCE DES ZONES DE GRAND CULTURE PAR TELLEDETECTION]

A. Perrier and P. Chartier /in CNES Remote Sensing of Earth Resources Oct. 1971 p 71-85 In FRENCH Original contains color illustrations

The reflection diffusion of electromagnetic waves by flowers, fruits, and foliage in the range from 0.4 to 3 microns range, and the emission of thermal radiation peculiar to each species in the range from 3 to 40 microns are studied. Results obtained from aerial IR photographs of species differentiation, surface homogeneity, effect of soil humidity, and irrigation are interpreted. The techniques for quantitative analysis are also assessed. ESRO

N72-28383 Institut National de la Recherche Agronomique, Paris (France). Station de Recherches Forestieres.

PARASITIC DAMAGE DETECTION IN THE MAURES, ESTEREL AND LANDES MARITIME PINE FORESTS [DETECTION D'ATTAQUES PARASITAIRES EN FORETS DE PINS MARITIMES DANS LES MAURES, L'ESTEREL ET LES LANDES]

J. Riom, J. P. Fabre, A. Boulbria, and B. Gerbinot /in CNES Remote Sensing of Earth Resources Oct. 1971 p 86-87 In FRENCH

(Contract DGRST-71-7-2624)

Different methods of detecting pine forest diseases caused by *Matsucoccus feytaudi* attack are briefly presented. It is shown that the best results are obtained with false color photographic emulsions. ESRO

N72-28384 Institut National de la Recherche Agronomique, Paris (France). Station de Biocenotique et de Lutte Biologique.

EVIDENCE OF EXTINCTION OF THE BEECH IN THE LYONS FOREST (EURE) FRANCE [MISE EN EVIDENCE DU DEPERISSEMENT DU HETRE EN FORET DE LYON (EURE) FRANCE]

C. B. Malphettes /in CNES Remote Sensing of Earth Resources Oct. 1971 p 88-94 In FRENCH Original contains color illustrations

The method for detecting beech tree diseases in the Lyons forest, caused by *Cryptococcus fagi* insects and *Nectria* fungi, is described. Results obtained from aerial photographs are interpreted. It is shown that the difference in colors of photographs enables classification of damaged trees into categories. It is concluded that remote sensing is a useful qualitative technique for the approach to the beech extinction problem in upper Normandy. ESRO

N72-28387 Centre National de la Recherche Scientifique, Toulouse (France). Service de la Carte de la Vegetation.

REMOTE SENSING OF VEGETATION LANDSCAPES [TELEDETECTION DES PAYSAGES VEGETAUX]

P. Rey /in CNES Remote Sensing of Earth Resources Oct. 1971 p 139-148 In FRENCH Original contains color illustrations

Results obtained from remote sensing techniques applied to vegetation terrain analysis are interpreted. They include aerial photographs of the Minervois de L'Aude and de L'Herault, Pays de Bray, and Val de Loire regions, thermographic data on the same regions, and data on the Aquitaine and Adour regions. The different techniques are evaluated. ESRO

N72-28388 Ecole Nationale Supérieure Agronomique, Grignon (France).

AERIAL PHOTOGRAPHS AND AGRICULTURAL ECOLOGY: ECOLOGICAL STUDY OF THE RAMBOUILLET FOREST [PHOTOGRAPHIES AERIENNES ET ECOLOGIE AGRICOLE: ETUDES ECOLOGIQUES DANS LA FORET DE RAMBOUILLET]

C.-M. Girard /in CNES Remote Sensing of Earth Resources Oct. 1971 p 149-174 In FRENCH Original contains color illustrations

N72-28347*# George Washington Univ., Washington, D.C. PLANNING AND PROGRAMING IN THE SOIL CONSERVATION SERVICE

Roy M. Gray (Dept. of Agr.) Jun. 1972 30 p refs Presented at Seminar No. 3 of an Evening Ser. on Technol. Assessment Methodology, Washington, D. C., 18 May 1972 (Grant NGL-09-010-030)

(NASA-CR-127436; GWPS-MON-13) Avail: NTIS HC \$3.75 CSCL 08M

The historical base is presented for the framework plan for soil conservation. Conservation effects, resource management systems, and accomplishments, activities, and costs of the Soil Conservation Service are discussed. K.P.D.

N72-28380 Institut National de la Recherche Agronomique, Paris (France). Service d'Etude des Sols et de la Carte Pedologique de France.

SOIL ANALYSIS FROM CNES SUMMER AND WINTER 1970-71 MISSIONS: PAYS DE BRAY SITE [ANALYSE PEDOLOGIQUE DES MISSIONS CNES ETE ET HIVER 1970-71: ZONE DU PAYS DE BRAY]

M. Isambert /in CNES Remote Sensing of Earth Resources Oct. 1971 p 50-58 Original contains color illustrations

Aerial photographs taken during July 1970 and February 1971 are interpreted for four different photographic emulsions. Results obtained from Cyclope scanner measurements are presented, and it is shown that due to Cyclope scanner thermal resolution limitations, the black and white photographic emulsions are the most suitable for study of the Pays de Bray area. ESRO

N72-28381 Institut National de la Recherche Agronomique, Paris (France).

SOIL ANALYSIS FROM CNES SUMMER AND WINTER 1970-71 MISSIONS: VAL DE LOIRE - SOLOGNE SITE [ANALYSE PEDOLOGIQUE DES MISSIONS CNES ETE ET HIVER 1970-71: ZONE VAL DE LOIRE - SOLOGNE]

P. Horemans /in CNES Remote Sensing of Earth Resources Oct. 1971 p 59-70 In FRENCH Original contains color illustrations

The aerial photographs taken during the July 1970 and February 1971 flights are interpreted for four different photographic emulsions. Results obtained from the Cyclope scanner measurements are presented, and it is shown that winter is the most favorable period for mapping the soil surface of Val de Loire by means of aerial photographs. The use of the Cyclope scanner, which gives thermal and hydrological information on the depth of the analyzed terrain, is emphasized. ESRO

N72-28382 Institut National de la Recherche Agronomique, Paris (France). Station Centrale de Bioclimatologie.

SURVEILLANCE OF AGRICULTURAL ZONES BY REMOTE

01 AGRICULTURE AND FORESTRY

Aerial photography is applied to agricultural species differentiation, determination of soil influence on crops and croplage, and chemical weed-killing zone detection. The detection of a vegetation accident in an oatfield is emphasized. Some vegetation ecological problems in the Rambouillet forest, France were studied using aerial photographs with different photographic emulsions. They include: tree species identification, the equilibrium between two sandy moor species, the localization of tree species, tree evolution, and *Pinus sylvestris* reforestation on a humid moor. ESRO

N72-28389 Ecole Nationale Supérieure Agronomique, Grignon (France).

STUDY OF SOIL AND CROPS IN THE GRIGNON EXPERIMENTAL FIELDS [ETUDE DES SOLS ET DES FAÇONS CULTURALES SUR LES PARCELLES EXPERIMENTALES DE GRIGNON]

M.-C. Girard / In CNES Remote Sensing of Earth Resources Oct. 1971 p 175-188 In FRENCH Original contains color illustrations

Results obtained from aerial photographs of the Grignon experimental fields on 5 March 1971 are presented. The terrain was analyzed and different ploughing zones were determined by means of color differentiation. Old and new Canadian ploughing zones were determined. ESRO

N72-29289* Natural Resources Management Corp., Berkeley, Calif. Research and Development Div.

INVESTIGATION OF THE DETECTION AND MONITORING OF FOREST INSECT INFESTATIONS IN THE SIERRA NEVADA MOUNTAINS OF CALIFORNIA Progress Report, Jun. - Jul. 1972

Ralph C. Hall, Principal Investigator Jul. 1972 6 p

(Contract NAS5-21770)

(E72-10017; NASA-CR-127496; NRM-A) Avail: NTIS HC \$3.00 CSCL 02F

N72-29274* Nebraska Univ., Lincoln.

MAPPING AND MANAGING SOIL AND RANGE RESOURCES IN THE SAND HILLS REGION OF NEBRASKA Progress Report, 1 Jun. - 31 Aug. 1972

James V. Drew, Principal Investigator 31 Aug. 1972 3 p

(Contract NAS5-21756)

(E72-10022; NASA-CR-127746) Avail: NTIS HC \$3.00 CSCL 08G

N72-29307* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

SPECTRAL REFLECTANCE MEASUREMENTS OF PLANT SOIL COMBINATIONS

N. H. MacLeod / In its 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 11 p

CSCL 02C

Field and laboratory observations of plant and soil reflectance spectra were made to develop an understanding of the reflectance of solar energy by plants and soils. A related objective is the isolation of factors contributing to the image formed by multispectral scanners and return beam vidicons carried by ERTS or film-filter combinations used in the field or on aircraft. A set of objective criteria are to be developed for identifying plant and soil types and their changing condition through the seasons for application of space imagery to resource management. This is because the global scale of earth observations satellites requires objective rather than subjective techniques, particularly where ground truth is either not available or too

costly to acquire. As the acquiring of ground truth for training sets may be impractical in many cases, attempts have been made to identify objectively standard responses which could be used for image interpretation. Author

N72-29331* Michigan Univ., Ann Arbor. Willow Run Labs. PREDICTION OF DIRECTIONAL REFLECTANCE OF A CORN FIELD UNDER STRESS

Gwynn H. Suits, Gene Safir (Mich. State Univ.), and A. Ellingboe (Mich. State Univ.) / In Nasa. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 11 p ref CSCL 02C

A vegetative canopy model concept is developed and used to calculate the directional spectral reflectance of a corn field under stress. The problem has been idealized by assuming that the canopy is represented in several layers of uniform but randomly distributed biological components; horizontal and vertical projection of leaves, for example, replaces the actual leaf. An accumulative horizontal projection leads to a quantitative horizontal leaf area index while accumulated vertical projections provide the vertical leaf index area for each layer. The spectral properties of the projections are obtained from the spectral properties of the biological components. These techniques together with soil reflectance data provide a physical description for the vegetative canopy and adequately interpret multispectral scanning data. G.G.

N72-29337* Kansas Univ./Center for Research, Inc., Lawrence. THE STATUS OF PARAMETRIC STUDIES IN RADAR AGRICULTURE

Stanley A. Morain / In NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 17 p refs

(Contract NAS9-10261)

CSCL 171

Outlined is an information system based on the use of remote sensor data and the design, testing, and implementation of interpretation keys for agriculture. The task of crop identification from radar imagery emphasizes dichotomous keys and the effects of frequency, angular and other microwave dependencies of crops for use in discrimination. A mosaic is formulated from imagery and used to study acres in wheat for spread of circular irrigation, spread of crops, and other phenomena. G.G.

N72-29345* Texas A&M Univ., College Station. Remote Sensing Center.

SPECTRAL REFLECTANCE MEASUREMENTS OF A VIRUS HOST MODEL

Robert W. Toler and N. K. Shankar (Lockheed Electronics Co., Houston, Tex.) / In NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 18 p Original contains color illustrations

CSCL 08A

A technique has been developed to detect the characteristic spectral signatures of healthy and infected St. Augustine grass. It is possible to predict the coverage of the infected area provided ground truth coverage shows positive St. Augustine grass turf. Qualitative measurements from photographs of plants in the blue and red regions with polarization show that light reflected from healthy plants is more strongly polarized than that from diseased plants. Photographs taken through the blue Wratten 47 filter in conjunction with a polarizer show an excellent differentiation. A large photographic difference also appears in the red region. Much smaller differences were noted in the 540 to 550 nm region. Although the intensity in the near-IR region is much higher than the visible region of the spectrum, differences in the healthy and diseased plants' reflectance were quite small. Author

N72-29347* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

DIFFERENTIATING ELEMENTS OF THE SOIL-VEGETATION COMPLEX

M. F. Baumgardner *In* NASA, Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 24 p refs

(Grant NGL-15-005-112)

CSCL 08M

The application of remote sensing to study soil-vegetation systems requires quantification and precise location of ground observation data such that they can be correlated with multispectral aerial acquired data. Gridding and sampling of an area for exact identification in a known address on magnetic tape containing multispectral scanner data produces quantitative physico-chemical parameters and the energy which is radiating from within the soil-vegetation complex of an area. Example classifications and spectral mappings of soils made from multispectral scanner data are included. G.G.

N72-29388* Aerojet-General Corp., El Monte, Calif. Microwave Div.

SOIL MOISTURE MAPPING BY GROUND AND AIRBORNE MICROWAVE RADIOMETRY

G. Poe and A. T. Edgerton *In* NASA, Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 23 p refs

CSCL 08M

Extensive ground-based and airborne investigations were undertaken in conjunction with laboratory dielectric measurements of soils and analytical modeling. Radiometric measurements were made in the vicinity of Phoenix, Arizona at observational wavelengths ranging from 0.81 to 21 cm. Ground experiments were conducted with a microwave field laboratory and airborne measurements were obtained from a CV-990 aircraft. Research activities were focused on establishing basic relationships between microwave emission and the distribution of moisture. Author

N72-29407* National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.

FOURTH ANNUAL EARTH RESOURCES PROGRAM REVIEW, VOLUME 5: AGRICULTURE AND FORESTRY PROGRAMS

21 Jan. 1972 281 p refs Rev. held at Houston, Tex., 17-21 Jan. 1972 Original contains color illustrations

(NASA-TM-X-68562; MSC-05937-Vol-5) Avail: NTIS HC \$16.25 CSCL 02F

The agriculture and forest earth resources programs are discussed, including the remote sensing equipment and techniques. The corn blight watch experiment is emphasized, among other infestation studies.

N72-29408* California Univ., Berkeley. Forestry Remote Sensing Lab.

DEVELOPMENT OF ANALYSIS TECHNIQUES FOR REMOTE SENSING OF VEGETATION RESOURCES

William C. Draeger *In* NASA, Manned Spacecraft Center 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 13 p Original contains color illustrations

CSCL 02C

Various data handling and analysis techniques are summarized for evaluation of ERTS-A and supporting high flight imagery. These evaluations are concerned with remote sensors applied to wildland and agricultural vegetation resource inventory problems. Monitoring California's annual grassland, automatic texture analysis, agricultural ground data collection techniques, and spectral measurements are included. J.A.M.

N72-29413* Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.

MICROSCALE PHOTO INTERPRETATION OF FOREST AND NONFOREST LAND CLASSES

Robert C. Aldrich and Wallace J. Greentree *In* NASA, Manned Spacecraft Center 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 21 p refs

CSCL 14E

Remote sensing of forest and nonforest land classes are discussed, using microscale photointerpretation. Results include: (1.) Microscale IR color photography can be interpreted within reasonable limits of error to estimate forest area. (2.) Forest interpretation is best on winter photography with 97 percent or better accuracy. (3.) Broad forest types can be classified on microscale photography. (4.) Active agricultural land is classified most accurately on early summer photography. (5.) Six percent of all nonforest observations were misclassified as forest. J.A.M.

N72-29414* Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.

POTENTIALITY FOR OBTAINING PORIA DISEASE SIGNATURES IN THE OREGON CASCADES FROM ORBITAL ALTITUDES

John F. Wear *In* NASA, Manned Spacecraft Center 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 19 p

CSCL 02F

A prime photographic signature indicator of an important forest disease was identified in valuable Douglas-fir stands of the Pacific Northwest. The disease signature was verified by a multidisciplinary team of scientists to be the direct result of the Poria weirii root-rot syndrome in the Douglas-fir and hemlock stands of the high Cascades in Oregon. It is readily discernible on small-scale suborbital photography and has good potential for detection from earth-orbiting satellites or remote sensing platforms. Author

N72-29415* Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.

PATTERN RECOGNITION OF NATIVE PLANT COMMUNITIES: MANITOU COLORADO TEST SITE

Richard S. Driscoll *In* NASA, Manned Spacecraft Center 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 28 p refs Original contains color illustrations

CSCL 09B

Optimum channel selection among 12 channels of multispectral scanner imagery identified six as providing the best information about 11 vegetation classes and two nonvegetation classes at the Manitou Experimental Forest. Intensive preprocessing of the scanner signals was required to eliminate a serious scan angle effect. Final processing of the normalized data provided acceptable recognition results of generalized plant community types. Serious errors occurred with attempts to classify specific community types within upland grassland areas. The consideration of the convex mixtures concept (effects of amounts of live plant cover, exposed soil, and plant litter cover on apparent scene radiances) significantly improved the classification of some of the grassland classes. Author

N72-29416* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

CORN BLIGHT WATCH EXPERIMENT RESULTS

C. J. Johannsen and M. E. Bauer *In* NASA, Manned Spacecraft Center 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 23 p Original contains color illustrations

(Grant NGL-15-005-112)

CSCL 02C

Results pertaining to the detection and assessment of the severity and extent of southern corn leaf blight in the Corn Belt area are discussed. Ground observations, interpretation of color infrared photography, and machine analysis of multispectral scanner data were used to identify the blight. Author

01 AGRICULTURE AND FORESTRY

N72-29417* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

THE CORN BLIGHT PROBLEM: 1970 AND 1971

Marvin E. Bauer /in NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 19 p

CSCL 02C

Southern corn leaf blight is caused by the fungus, *Helminthosporium maydis*. Race T of H maydis adapted itself to the Texas male sterile cytoplasm corn. The problems caused by this variety of the blight in 1970 and 1971 are discussed, as well as the symptoms and development of the disease. J.A.M.

N72-29418* Department of Agriculture, Washington, D.C. Statistical Reporting Service.

CORN BLIGHT REVIEW: SAMPLING MODEL AND GROUND DATA MEASUREMENTS PROGRAM

Richard Allen /in NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 23 p

CSCL 02C

The sampling plan involved the selection of the study area, determination of the flightline and segment sample design within the study area, and determination of a field sample design. Initial interview survey data consisting of crop species acreage and land use were collected. On all corn fields, additional information such as seed type, row direction, population, planting date, etc were also collected. From this information, sample corn fields were selected to be observed through the growing season on a biweekly basis by county extension personnel. Author

N72-29422* Department of Agriculture, Washington, D.C. Program Performance Div.

THE 1971 CORN BLIGHT WATCH EXPERIMENT

J. W. Clifton /in NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 5 p

CSCL 02C

The successful fulfillment of the objectives for the 1971 corn blight watch experiment is reported. The objectives were: (1) detect the development and spread of corn blight during the growing season across the Corn Belt; (2) assess different levels of infection in the Corn Belt; (3) amplify data acquired by ground observations to better appraise current blight status and the probable impact on crop production; and (4) estimate through extrapolation the applicability of these techniques to similar situations occurring in the future. J.A.M.

N72-29432* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

DIELECTRIC CONSTANTS OF SOILS AT MICROWAVE FREQUENCIES

F. E. Geiger and Donald Williams Apr. 1972 34 p refs (NASA-TM-X-65987; X-652-72-283) Avail: NTIS HC \$3.75 CSCL 08M

A knowledge of the complex dielectric constant of soils is essential in the interpretation of microwave airborne radiometer data of the earth's surface. Measurements were made at 37 GHz on various soils from the Phoenix, Ariz., area. Extensive data have been obtained for dry soil and soil with water content in the range from 0.6 to 35 percent by dry weight. Measurements were made in a two arm microwave bridge and results were corrected for reflections at the sample interfaces by solution of the parallel dielectric plate problem. The maximum dielectric constants are about a factor of 3 lower than those reported for similar soils at X-band frequencies. Author

N72-31328* California Univ., Riverside. Dept. of Plant Sciences.

EVALUATION OF REMOTE SENSING IN CONTROL OF

PINK BOLLWORM IN COTTON Progress Report, Jul. 1972

Lowell N. Lewis, Principal Investigator and Virginia Coleman 18 Sep. 1972 1 p

(Contract NAS5-21771)

(E72-10037; NASA-CR-127886) Avail: NTIS HC \$3.00 CSCL 08F

N72-31337* California Univ., Berkeley. Space Sciences Lab. ERTS-1 APPLICATIONS TO CALIFORNIA RESOURCE INVENTORY

Robert N. Colwell, Principal Investigator 29 Sep. 1972 7 p Presented as Preliminary Findings from Analyses of ERTS Observations, NASA Goddard Space Flight Center, Greenbelt, Md., 29 Sep. 1972 Original contains color illustrations. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S.D. 57198 (Contract NAS5-21827)

(E72-10046; NASA-CR-128125) Avail: NTIS HC \$3.00 CSCL 08F

There are no author-identified significant results in this report. ERTS-1 information will be utilized by resource management groups working in the fields of forestry, hydrology, range management, and agriculture to develop resource inventories of the state of California. Five examples are given of the use of ERTS-1 imagery and aerial photography in identifying different crops and field conditions. A.L.

N72-31357* Purdue Univ., Lafayette, Ind. Lab. for Application of Remote Sensing.

EVALUATION AND COMPARISON OF ERTS MEASUREMENTS OF MAJOR CROPS AND SOIL ASSOCIATIONS FOR SELECTED SITES IN THE CENTRAL UNITED STATES

Progress Report, 1 Jul. - 31 Aug. 1972

Marion F. Baumgardner, Principal Investigator 5 Sep. 1972 3 p Sponsored by NASA

(E72-10075; NASA-CR-128090) Avail: NTIS HC \$3.00 CSCL 08B

N72-31372* Forest Economics Research Inst., Ottawa (Ontario). THE ECONOMICS OF REMOTE SENSING OF FOREST LAND

H. Rae Grinnell and Michael S. Conway [1971] 13 p refs Avail: NTIS HC \$3.00

The output of remote sensing systems is discussed in terms of economics, early development, and effective use in Canada. Opportunities to increase benefits from current systems depend on clear objectives for the multiple use of a limited number of image resolutions derived at specific time intervals. The fractionated incomplete photo coverage of Canada and the low unit cost of standardized scales are suggested as ample reasons to bring about some rationalization of the current multi-view approach to resource surveying in Canada. Author

N72-31374* Forest Management Inst., Ottawa (Ontario).

AIR PHOTO COVERAGE FOR CANADIAN FORESTRY

Murray G. Bowen Dec. 1971 85 p refs Original contains color illustrations (FMR-X-38) Avail: NTIS HC \$6.25

The report, based upon recent information obtained from Canada's National Air Photo Library and the Provinces of New Brunswick, Quebec, Ontario, Alberta and British Columbia, shows by means of 66 maps, by province and territory, the location and extent of the air photo coverage of Canada obtained during the

period 1966 to October 1970, which may be useful to forestry. Federal and provincial coverage is shown separately and while no private coverage is shown, advice is given, as on governmental sources, on the sources of copies of private air photos. A brief history, together with references, of Canada's air photo coverage, is also included. Author

N72-31379# Forest Management Inst., Ottawa (Ontario).
A NEW APPROACH TO THE DESCRIPTION OF THE FOREST REGIONS OF CANADA USING 1:160,000 COLOR INFRARED AERIAL PHOTOGRAPHY
 U. Nielsen and J. M. Wightman Aug. 1971 30 p refs
 (FMR-X-35) Avail: NTIS HC \$3.50

Color infrared aerial photography at a scale of 1:160,000, provided suitable images for the delineation of forest sections based on a classification criteria used by Rowe in Forest Regions of Canada. This is demonstrated by sample stereo pairs and mosaics included in the report. It is concluded that ultra-small scale aerial photography, of the quality studied, provides enough information to undertake even more detailed forest typing than outlined here. Author

N72-31443# Wisconsin Univ., Madison. Center for Climatic Research.
VEGETATION AND TERRAIN (ENVIRONMENT): CANADIAN BOREAL FOREST AND TUNDRA Final Report, 1970-1972

James A. Larsen Feb. 1972 246 p refs
 (Grants DA-ARO(D)-31-124-70-G43;
 DA-ARO(D)-31-126-G1128)
 (AD-742724; UW-G1128; AROD-8058:3-EN) Avail: NTIS CSCL 06/6

Vegetational and terrain data from 44 study sites in boreal forest and tundra of Canada west of Hudson Bay are employed to discern relationships between vegetation and climate, describe structural characteristics of vegetational communities, provide interpretation of vegetational and terrain features from aerial photographs (photo-interpretive keys), establish a generalized systematic categorization of the region based on vegetation, climate, terrain, topography, and surficial geology, and subdivide the entire area into regions. Author (GRA)

N72-31448# Ecole Polytechnique, Montreal (Quebec). Dept. of Geological Engineering.

MULTISPECTRAL IMAGERY AND AUTOMATIC CLASSIFICATION OF SPECTRAL RESPONSE FOR DETAILED ENGINEERING SOILS MAPPING

Marc G. Tanguay, Roger M. Hoffer (Purdue Univ.), and Robert D. Miles (Purdue Univ.) [1972] 31 p refs Sponsored by Bur. of Public Roads and Indiana State Highway Comm.
 Avail: NTIS HC \$3.75

The project involved the evaluation of imagery taken in fifteen discrete bands of the spectrum as a source of data on engineering soils. The multispectral data was evaluated by (1) visual means, (2) densitometric measurements, and (3) an automatic spectral response classification method. Classification maps representing seven soil types of different engineering significance were obtained. There is an indication that useful automatic classification of soils can be made and printed on a computer map using multispectral data collected between the ultraviolet and the far infrared range of the spectrum. Information on limited laboratory reflectance measurements is also reported. Author

N72-32337*# Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.
INVENTORY OF FOREST AND RANGELAND AND

DETECTION OF FOREST STRESS Progress Report, 1 Jul. - 31 Aug. 1972

Robert C. Heller, Principal Investigator, Robert C. Aldrich, Frederick P. Weber, and Richard S. Driscoll 8 Sep. 1972 12 p
 (NASA Order S-70251-AG)
 (E72-10070; NASA-CR-128085; FS-I-1; PR-1) Avail: NTIS HC \$3.00 CSCL 02F

The author has identified the following significant results. Seventy-two ground sensors were interfaced with three DCP's at the Black Hills test site. Unfortunately, the transmitters had to be returned for modification and forestry sensed data is not available. The DCP's did operate properly from the Berkeley laboratory and data were recovered from the Goldstone and Alaska stations via Goddard. Replicated training sets and test sets have been selected from all three test site areas in preparation for the receipt of ERTS imagery and digital tapes. From 600 and 800 points have been selected at each site location and UTM coordinates determined. Templates are being made of these sets. As of September 1, ERTS-generated data had not been received and no statements can be made regarding quality or suitability for forest and range experiments. Aerial photography (scale 1:32,000) of the Manitou (226 C) and Black Hills (226 A) sites was taken with CIR in June. Various scales (1:2,000; 1:10,000; 1:20,000; and 1:40,000) of 70 mm photographs were obtained at Manitou with normal color, CIR, and panchromatic in August.

N72-32343*# Bureau of Land Management, Riverside, Calif.
PREDICT EPHEMERAL AND PERENNIAL RANGE QUANTITY AND QUALITY DURING NORMAL GRAZING SEASON Progress Report, 1 Jul. - 31 Aug. 1972

Gordon Bentley, Principal Investigator 1 Sep. 1972 2 p
 Sponsored by NASA
 (E72-10090; NASA-CR-128139) Avail: NTIS HC \$3.00 CSCL 04B

N72-32358*# Bureau of Sport Fisheries and Wildlife, Jamestown, N.D.

APPRAISING CHANGES IN CONTINENTAL MIGRATORY BIRD HABITAT Progress Report, 1 Jul. - 31 Aug. 1972

Harvey K. Nelson, Principal Investigator 1 Sep. 1972 3 p
 Sponsored by NASA
 (E72-10106; NASA-CR-128155) Avail: NTIS HC \$3.00 CSCL 06C

N72-32365*# Geological Survey, Tucson, Ariz.

DYNAMICS OF DISTRIBUTION AND DENSITY OF PHREATOPHYTES AND OTHER ARID LAND PLANT COMMUNITIES Progress Report, 1 Jul. - 31 Aug. 1972

Raymond M. Turner, Principal Investigator 1 Sep. 1972 2 p
 Sponsored by NASA
 (E72-10114; NASA-CR-128163) Avail: NTIS HC \$3.00 CSCL 08F

N72-32366*# Bureau of Sport Fisheries and Wildlife, Washington, D.C.

AN EVALUATION OF SPACE ACQUIRED DATA AS A TOOL FOR MANAGEMENT OF WILDLIFE HABITAT IN THE STATE OF ALASKA Progress Report, 1 Jul. - 31 Aug. 1972

Billy J. VanTries, Principal Investigator 1 Sep. 1972 3 p
 Sponsored by NASA
 (E72-10115; NASA-CR-128164) Avail: NTIS HC \$3.00 CSCL 08F

01 AGRICULTURE AND FORESTRY

N72-32367*# Bureau of Indian Affairs, Washington, D.C.
TIMBER RESOURCE INFORMATION SYSTEM Progress Report, 1 Jul. - 31 Aug. 1972
Arthur M. Woll, Principal Investigator 5 Sep. 1972 2 p
Sponsored by NASA
(E72-10116; NASA-CR-128165) Avail: NTIS HC \$3.00 CSCL 02F

N72-32368*# Purdue Univ., Lafayette, Ind.
PRELIMINARY RESULTS ON AUTOMATIC IDENTIFICATION OF FOREST AND AGRICULTURAL COVER TYPES UTILIZING ERTS-1 DATA OVER THE WABASH RIVER BASIN
Roger M. Hoffer, Principal Investigator and David A. Landgrebe, Principal Investigator 3 Oct. 1972 2 p
(E72-10118; NASA-CR-128167) Avail: NTIS HC \$3.00 CSCL 08F

N72-32374*# Kansas State Univ., Manhattan.
WHEAT: ITS WATER USE, PRODUCTION AND DISEASE DETECTION AND PREDICTION Progress Report
Edward T. Kanemasu, Principal Investigator 22 Sep. 1972 3 p
(Contract NAS5-21822)
(E72-10126; NASA-CR-128180) Avail: NTIS HC \$3.00 CSCL 02D

N72-32375*# Kansas Univ., Lawrence.
APPLICATION OF ERTS DATA TO KANSAS AGRICULTURE Monthly Progress Report, Sep. 1972
Stanley A. Morain, Principal Investigator Oct. 1972 5 p
Sponsored by NASA
(E72-10127; NASA-CR-128181) Avail: NTIS HC \$3.00 CSCL 02B

N72-32382*# Alaska Univ., College.
APPLICATION OF ERTS-1 IMAGERY TO THE STUDY OF CARIBOU MOVEMENTS AND WINTER DISPERSAL IN RELATION TO PREVAILING SNOWCOVER Bimonthly Progress Report
Peter C. Lent, Principal Investigator 30 Sep. 1972 3 p
Sponsored by NASA
(E72-10134; NASA-CR-128188; BMPR-1) Avail: NTIS HC \$3.00 CSCL 08F

N72-32386*# Alaska Univ., College.
IDENTIFICATION OF PHENOLOGICAL STAGES AND VEGETATIVE TYPES FOR LAND USE CLASSIFICATION Bimonthly Progress Report
C. Ivan Branton, Principal Investigator 30 Sep. 1972 2 p
Sponsored by NASA
(E72-10138; NASA-CR-128192; BMPR-1) Avail: NTIS HC \$3.00 CSCL 08F

N72-33305*# California Univ., Riverside. Dept. of Plant Sciences.
EVALUATION OF REMOTE SENSING IN CONTROL OF

PINK BOLLWORM IN COTTON Progress Report, Aug. Sep. 1972
Lowell N. Lewis, Principal Investigator and Virginia B. Coleman
Sep. 1972 7 p refs Sponsored by NASA
(E72-10147; NASA-CR-127332) Avail: NTIS HC \$3.00 CSCL 06F

N72-33308*# Centre for Overseas Pest Research, London (England).
DETECTION OF POTENTIAL LOCUST BREEDING SITES Progress Report, 23 Jul. - 22 Oct. 1972
D. E. Pedgley, Principal Investigator 23 Oct. 1972 1 p
Sponsored by NASA
(E72-10150; NASA-CR-128286) Avail: NTIS HC \$3.00 CSCL 06C

N72-33316*# Arizona Univ., Tucson.
A STUDY TO EXPLORE THE USE OF ORBITAL REMOTE SENSING TO DETERMINE NATIVE ARID PLANT DISTRIBUTION Progress Report
William G. McGinnies, Principal Investigator 10 Oct. 1972 1 p
Sponsored by NASA
(E72-10159; NASA-CR-128310) Avail: NTIS HC \$3.00 CSCL 06C

N72-33319*# Michigan State Univ., East Lansing.
USE OF DATA FOR A MULTIDISCIPLINARY ANALYSIS OF MICHIGAN RESOURCES. TASK 1: ANALYSIS OF FORESTS AND RELATED NATURAL RESOURCES. TASK 2: ANALYSIS OF AGRICULTURAL CROPS. TASK 3: EVALUATION OF SOILS, SOIL CONDITIONS, AND LANDFORMS Progress Report
Wayne L. Myers, Principal Investigator, A. H. Ellingboe, Principal Investigator, and E. P. Whiteside, Principal Investigator 1 Oct. 1972 4 p
(Contract NAS5-21834)
(E72-10162; NASA-CR-128313; PR-1) Avail: NTIS HC \$3.00 CSCL 02F

N72-33322*# Cornell Univ., Ithaca, N.Y.
PHENOLOGY SATELLITE EXPERIMENT
Bernard E. Dethier, Principal Investigator 4 Oct. 1972 2 p
(Contract NAS5-21781)
(E72-10165; NASA-CR-128349) Avail: NTIS HC \$3.00 CSCL 14E

N72-33326# Centre for Overseas Pest Research, London (England).
USE OF SATELLITES AND RADAR IN LOCUST CONTROL
D. E. Pedgley 15 Sep. 1972 6 p refs Presented at Symp. on Remote Sensing, Bristol, Engl., 2 Oct. 1972
Avail: NTIS HC \$3.00

After outlining the population dynamics of the desert locust, the current use of meteorological satellites in helping to locate cloud systems that can give rains sufficient for breeding is discussed. An experiment is described in which the first Earth

Resources Technology Satellite is to be used to test the feasibility of directly locating potential breeding sites, i.e. ground that has been wetted by such rains, and where vegetation is becoming greener. Studies are mentioned in which radar has been used to examine the flight of solitary locusts and to locate wind systems near which flying populations are likely to be concentrated. Some possible lines for future development are given.

Author

N72-33328# California Univ., Berkeley. Forestry Remote Sensing Lab.

TESTING THE USEFULNESS OF SIDE LOOKING AIRBORNE RADAR IMAGERY FOR EVALUATING FOREST VEGETATION RESOURCES Final Report

Steven J. Daus and Donald T. Lauer 31 May 1971 79 p refs A fully illustrated report can be obtained on loan from the Forestry Remote Sensing Lab., Calif. Univ., Berkeley (Contract CRINC-1775-9)

Avail: NTIS HC \$6.00 CSCL 02F

An experiment was conducted to determine the usefulness of like-polarized AN/APQ-97 side looking airborne radar (SLAR) imagery for evaluating wildland vegetation resources in the northern Sierra Nevada Mountains of California. Results indicate that utilization of AN/APQ-97 SLAR imagery as a vegetation inventory tool encounters severe limitations since the combination effect of variable topography and the unidirectional (line-of-sight) characteristics of the SLAR system generally produces an image not characteristic of the vegetation resource, but of the topographic conformation. Useful topographic and geographic information is extractable from the SLAR imagery, and, for relatively flat terrain, tonal and textural variations associated with differences in vegetation cover often are discernible.

Author

N72-33330*# Arizona Univ., Tucson. Office of Arid Lands Studies.

THE USE OF HIGH ALTITUDE REMOTE SENSING IN DETERMINING EXISTING VEGETATION AND MONITORING ECOLOGICAL STRESS

Kenneth Foster and Alex Garcia Aug. 1972 33 p (Grant NGL-03-002-313)

(NASA-CR-128377; OALS-Bull-2) Avail: NTIS HC \$3.75 CSCL 08M

High altitude color and multispectral black and white photography was used to survey existing vegetation and soil conditions on the Empire Ranch where large scale development will soon begin. Utilizing stereo pairs of the high altitude color photography, four vegetation classifications were discernable as a function of topography and foliage characteristics. In contrast to the undeveloped Ranch, the same photography was used to detect environmental changes in the Tucson metropolitan area as a result of rapid urbanization. The most prevalent change related to development is the removal of vegetation in high density areas to allow for housing starts. Erosion then occurs where vegetation has been removed.

Author

N72-33331*# Arizona Univ., Tucson. Office of Arid Lands Studies.

GENERAL SOIL MAP LOWER PANTANO WASH AREA, PIMA COUNTY, ARIZONA

M. L. Richardson (Dept. of Agr.) Jun. 1972 34 p refs Original contains color illustrations (Grant NGL-03-002-313)

(NASA-CR-128376; OALS-Bull-1) Avail: NTIS HC \$3.75 CSCL 08M

High altitude color photography was used to determine soil type variation over large areas at a contact print scale of 1:125,000. It was found that color variation and land form could be used as a basis for assigning seven soil mapping units to the area as depicted on stereoscopic pairs of the color photography. A unit is assigned by soil scientists on the basis of similarity of soil features in the area to predetermined physical and chemical characteristics of the same soil type.

Author

N72-33347# Army Cold Regions Research and Engineering Lab., Hanover, N.H.

SOILS OF THE CARIBOU-POKER CREEKS RESEARCH WATERSHED, INTERIOR ALASKA

Samuel Rieger, Clarence E. Furbush, Dale B. Schoephorster, Harry Summerfield, Jr., and Luther C. Geiger Apr. 1972 22 p (AD-744451; CRREL-TR-236) Avail: NTIS CSCL 08/13

Soils of the 41.5 sq miles Caribou-Poker Creeks Research Watershed, central Alaska, have been mapped by standard Soil Conservation Service (USDA) methods. Seven soil series are recognized: Bradway silt loams, Ester silt loams, Karshner silt loams and Saulich silt loams, all underlain by permafrost at shallow depth, make up 27% of the basin area. Olnes silt loams, Gilmore silt loams and Fairplay silt loams, covering 73% of the watershed area, are free from permafrost. Areal distribution of soils is depicted on a photo-mosaic base at 1:31,680 scale.

Author (GRA)

N72-33781* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

SOIL MOISTURE MEASUREMENTS WITH MICROWAVE RADIOMETERS

Thomas J. Schmugge *In its Significant Accomplishments in Sci.*, 1971 Jun. 1972 p 3-6

CSCL 08M

One technique of measuring moisture content that appears promising is that of microwave radiometry. In the microwave region of the spectrum, the emissivity of water is approximately 0.4, whereas that of dry soil is approximately 0.9. Therefore, the emissivity of the soil can range from about 0.6 to 0.9 as the soil changes from a wet to a dry condition. Recent ground base measurements have demonstrated emissivity changes of this magnitude. To test the use of this approach for remote sensing of soil moisture, flights were made over agricultural test sites in the vicinity of Phoenix, Ariz., during late February 1971. On the same day, soil moisture measurements were made on the ground for 200 fields. On board the aircraft were six microwave radiometers, ranging in wavelength from 21 cm to 8 mm. The results of one of these radiometers are presented.

Author

N73-10354*# Nebraska Univ., Lincoln.

PROPOSAL TO EVALUATE THE USE OF ERTS-A IMAGERY IN MAPPING AND MANAGING SOIL AND RANGE RESOURCES IN THE SAND HILLS REGION OF NEBRASKA

Progress Report

James V. Drew, Principal Investigator 31 Oct. 1972 8 p (Contract NAS5-21756)

(E72-10175; NASA-CR-128412) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. Visual examination of RB-57F color infrared imagery of range sites within Test Site 313 indicates that early season imagery will show significant differences in appearance of sub-irrigated sites as compared to dry valley sites. Differences appear to be significant also when comparing the previous two sites to sands sites. Comparison of existing soil map soils delineations with vegetative growth patterns shows reasonably good agreement between the two patterns over rather broad areas. Visual examination of ERTS-1 imagery has also shown that rangeland burned by prairie fire within the last six months can be distinguished. Three confirmed fire areas have been shown on the imagery. Since only broad estimates of burned acres are available, more accurate acreage measurements will be attempted. Known acreage of burned areas will be of value to those agencies responsible for deferred grazing payments to land owners. The relative speed with which this acreage information would become available to these agencies through ERTS-1 imagery would be of much benefit.

A.L.

N73-10355*# Oregon State Univ., Corvallis.

LANDFORM VEGETATION RELATIONSHIPS IN SOUTHERN ARIZONA

Barry J. Schrupf, Principal Investigator and David A. Mouat 20 Oct. 1972 3 p Presented at Intern. Conf. on Remote

01 AGRICULTURE AND FORESTRY

Sensing in Arid Lands, Tucson, Ariz., 9 Nov. 1972
(Contract NAS5-21831)
(E72-10176; NASA-CR-128413) Avail: NTIS HC \$3.00 CSCL
08F

N73-10356*# Department of Agriculture, Washington, D.C.
**CROP IDENTIFICATION AND ACREAGE MEASUREMENT
UTILIZING ERTS IMAGERY** Progress Report, 20 Aug. -
19 Oct. 1972
Donald H. VonSteen, Principal Investigator 19 Oct. 1972 13 p
Sponsored by NASA
(E72-10179; NASA-CR-128326) Avail: NTIS HC \$3.00 CSCL
08B

There are no author-identified significant results in this report. The microdensitometer will be used to analyze data acquired by ERTS-1 imagery. The classification programs and software packages have been acquired and are being prepared for use with the information as it is received. Photo and digital tapes have been acquired for coverage of virtually 100 percent of the test site areas. These areas are located in South Dakota, Idaho, Missouri, and Kansas. Hass 70mm color infrared, infrared, black and white high altitude aerial photography of the test sites is available. Collection of ground truth for updating the data base has been completed and a computer program written to count the number of fields and give total acres by size group for the segments in each test site. Results are given of data analysis performed on digitized data from densitometer measurements of fields of corn, sugar beets, and alfalfa in Kansas. A.L.

N73-10333*# Oregon State Univ., Corvallis.
INVENTORY AND MONITORING OF NATURAL VEGETATION AND RELATED RESOURCES IN AN ARID ENVIRONMENT BY THE USE OF ERTS-A IMAGERY Progress Report, period ending 31 Oct. 1972
Barry J. Schrumph, Principal Investigator 9 Nov. 1972 8 p
(Contract NAS5-21831)
(E72-10184; NASA-CR-128382; PR-1) Avail: NTIS HC
\$3.00 CSCL 08F

The author has identified the following significant results. The southern Arizona test site includes vegetation representing shrub types of the Sonoran and Chihuahuan Deserts and Arizona chaparral. Also represented are grassland types of the desert grassland, juniper, and oak woodland types, and coniferous forest types. Relationships between plant species and selected terrain features are given along with the terrain feature classes used for the analyses. The purpose for determining the degree to which such relationships exist is to develop a body of knowledge to constitute the associated evidence that a photointerpreter may consult when interpreting vegetation subjects on small scale imagery. Imagery of this scale class contains little image detail which can be interpreted directly in terms of vegetation. On the other hand, some terrain features are the most salient features of that same imagery. Exploitation of those features for vegetation identification, inventory, and analysis can be accomplished only after establishing the existence of ecological relationships.

N73-10365*# Earth Satellite Corp., Berkeley, Calif.
**INVESTIGATION TO DEVELOP A MULTISTAGE FOREST
SAMPLING INVENTORY SYSTEM USING ERTS-1 IMAGERY**
Monthly Progress Report
Philip G. Langley, Principal Investigator 10 Nov. 1972 4 p
Sponsored by NASA
(E72-10186; NASA-CR-128384) Avail: NTIS HC \$3.00 CSCL
08F

N73-10999# Intermountain Forest and Range Experiment
Station, Ogden, Utah.
**AN INVENTORY DESIGN USING STAND EXAMINATIONS
FOR PLANNING AND PROGRAMING TIMBER MANAGE-
MENT** Final Research Paper, 1970-1971

Albert R. Stage May 1972 23 p refs
(PB-210276; FSRP-INT-126) Avail: NTIS CSCL 02F

Considerations guiding the design of a forest inventory for providing in place data for planning and programming timber management are discussed. The inventory procedure uses field examination of stands in sample subcompartments augmented by aerial photo interpretation of conditions in compartments and subcompartments not examined on the ground. The data are compiled to provide timber information that can be stratified with respect to land use zones, size of stand, accessibility, land stability, productivity, and by restrictions imposed by competing uses. Author (GRA)

N73-11300*# Idaho Univ., Moscow. Coll. of Forestry, Wildlife and Range Sciences.
**APPLICATION OF REMOTE SENSING IN THE STUDY OF
VEGETATION AND SOILS IN IDAHO**
E. W. Tisdale, Principal Investigator 13 Nov. 1972 1 p
Sponsored by NASA
(E72-10203; NASA-CR-129069) Avail: NTIS HC \$3.00 CSCL
08F

N73-11313*# Pacific Southwest Forest and Range Experiment
Station, Berkeley, Calif.
**INVENTORY OF FOREST AND RANGELAND AND DETEC-
TION OF FOREST STRESS** Progress Report, 1 Sep. -
31 Oct. 1972
Robert C. Heller, Robert C. Aldrich, Frederick P. Weber, and
Richard S. Driscoll, Principal Investigators 8 Nov. 1972 11 p
refs
(NASA Order S-70251-AG)
(E72-10219; NASA-CR-128485; PR-2) Avail: NTIS HC
\$3.00 CSCL 02F

There are no author-identified significant results in this report. Some ERTS-1 imagery has been received for each of the test sites: Black Hills, Atlanta, and Manitou. Only small portions of each site are covered and clouds have precluded capturing good imagery over the center of each site. Discoloration infestations of ponderosa pine are being located and sized on CIR transparencies. A computer program was completed from microdensitometer scans of CIR photos which maps areas of an image which are spectrally similar. Decided differences between forest types are present as well as differences between forest and other vegetative and nonvegetative land classes. A.L.

N73-11314*# Pacific Southwest Forest and Range Experiment
Station, Berkeley, Calif.
**REMOTE SENSING IN RESOURCE EVALUATION, PLAN-
NING, PROTECTION AND MANAGEMENT**
Robert C. Heller, Arthur M. Woll, Principal Investigators (Bur. of
Indian Affairs, Washington, D. C.), and Benjamin Spada 18 Oct.
1972 12 p Presented at 7th World Forestry Congr., Buenos
Aires, 4-18 Oct. 1972
(NASA Order S-70251-AG)
(E72-10220; NASA-CR-129088) Avail: NTIS HC \$3.00 CSCL
02F

N73-11315*# Pacific Southwest Forest and Range Experiment
Station, Berkeley, Calif.
**REMOTE SENSING IN FORESTRY: PROMISES AND
PROBLEMS.**
Robert C. Heller, Principal Investigator 4 Oct. 1972 16 p
Presented at Natl. Meeting of the Soc. of Am. Foresters,
Hot Springs, Ark., 4 Oct. 1972 Submitted for publication
(NASA Order S-70251-AG)
(E72-10221; NASA-CR-129089) Avail: NTIS HC \$3.00 CSCL
02F

**N73-11321*# Oregon State Univ., Corvallis.
VEGETATION-TERRAIN FEATURE RELATIONSHIPS IN
SOUTHEAST ARIZONA**

Barry J. Schrupf, Principal Investigator and David A. Mout
27 Nov. 1972 19 p refs Presented at Intern. Conf. on Remote
Sensing in Arid Lands
(Contract NAS5-21831)
(E72-10228; NASA-CR-129181) Avail: NTIS HC \$3.00 CSCL
08F

There are no author-identified significant results in this report. Studies of relationships of vegetation distribution to geomorphic characteristics of the landscape and of plant phenological patterns to vegetation identification of satellite imagery indicate that there exists positive relationships between certain plant species and certain terrain features. Not all species were found to exhibit positive relationships with all terrain feature variables, but enough positive relationships seem to exist to indicate that terrain feature variable-vegetation relationship studies have a definite place in plant ecological investigations. Even more importantly, the vegetation groups examined appeared to be successfully discriminated by the terrain feature variables. This would seem to indicate that spatial interpretations of vegetation groups may be possible. While vegetational distributions aren't determined by terrain feature differences, terrain features do mirror factors which directly influence vegetational response and hence distribution. As a result, those environmental features which can be readily and rapidly ascertained on relatively small-scale imagery may prove to be valuable indicators of vegetation distribution.

A.L.

N73-11324*# Tennessee Univ., Knoxville. Dept. of Electrical Engineering.

**ERTS-A IMAGERY INTERPRETATION TECHNIQUES IN THE
TENNESSEE VALLEY Progress Report, 25 Sep. - 25 Nov.
1972**

Robert E. Bodenheimer, Principal Investigator 29 Nov. 1972
2 p Sponsored by NASA
(E72-10231; NASA-CR-129105) Avail: NTIS HC \$3.00 CSCL
08F

**N73-11325*# Purdue Univ., Lafayette, Ind. Lab. for Application
of Remote Sensing.**

**EVALUATION AND COMPARISON OF ERTS MEASURE-
MENTS OF MAJOR CROPS AND SOIL ASSOCIATIONS FOR
SELECTED SITES IN THE CENTRAL UNITED STATES
Bimonthly Progress Report, 1 Sep. - 31 Oct. 1972**

Marion F. Baumgardner, Principal Investigator 31 Oct. 1972
3 p Sponsored by NASA
(E72-10232; NASA-CR-129106) Avail: NTIS HC \$3.00 CSCL
08F

**N73-11343# Michigan Univ., Ann Arbor. Willow Run Labs.
A STUDY OF WATER FOWL HABITAT IN NORTH DAKOTA
USING REMOTE SENSING TECHNIQUES Final Report,
1 May 1969 - 31 Jan. 1970**

W. G. Burge and W. L. Brown Jul. 1970 71 p refs Original
contains color illustrations
(Contract USGS-14-08-0001-11950)
(USGS-IR-215) Avail: NTIS HC \$5.75; USGS

Airborne multispectral data were gathered at two altitudes (2000 ft and 10,000 ft above terrain) for the U.S. Geological Survey in May 1968 using the optical-mechanical scanner over waterfowl nesting habitat near Jamestown, North Dakota. Subsequent data analysis was conducted to assess the feasibility of obtaining indirectly an estimate of annual waterfowl production using current remote sensing technology. Experiments on this data demonstrated the ability of analog and digital computer-implemented instrumentation to recognize and map selected materials and/or features on the basis of their spectral characteristics. Most of the recognition work was performed with a special-purpose analog computer. Recognition of materials, such as pond water, marsh vegetation, bare soil, upland vegetation,

and cultural features, using the low altitude data, was quite successful. Using high altitude data was moderately successful in automatically recognizing pond water, bare soil, upland vegetation, and cultural features. From the low altitude data, statistical summaries and distributions of pond area, pond perimeter, and pond shape were obtained by performing digital operations on recognition data and seem more accurate than measurements from aerial photographs.

Author

**N73-12335*# Bureau of Sport Fisheries and Wildlife, Jamestown,
N.D. Northern Prairie Wildlife Research Center.**

**APPRAISING CHANGES IN CONTINENTAL MIGRATORY
BIRD HABITAT Progress Report, 1 Sep. - 31 Oct. 1972**

Harvey K. Nelson, Principal Investigator 9 Oct. 1972 4 p
Sponsored by NASA
(E72-10235; NASA-CR-129112) Avail: NTIS HC \$3.00 CSCL
08F

N73-12343*# Geological Survey, Tucson, Ariz.

**DYNAMICS OF DISTRIBUTION AND DENSITY OF PHREAT-
OPHYTES AND OTHER ARID-LAND PLANT COMMUNITIES
Progress Report, 1 Sep. - 31 Oct. 1972**

Raymond M. Turner, Principal Investigator 1 Nov. 1972 2 p
Sponsored by NASA
(E72-10243; NASA-CR-129120) Avail: NTIS HC \$3.00 CSCL
08F

N73-12345*# Bureau of Indian Affairs, Washington, D.C.

**TIMBER RESOURCE INFORMATION SYSTEM Progress
Report, 1 Sep. - 31 Oct. 1972**

Arthur M. Woll, Principal Investigator 27 Nov. 1972 2 p
Sponsored by NASA
(E72-10245; NASA-CR-129122) Avail: NTIS HC \$3.00 CSCL
02F

N73-12353*# Nevada Univ., Reno.

**USE OF SATELLITE IMAGERY FOR WILDLAND RESOURCE
EVALUATION Progress Report**

Paul T. Tueller, Principal Investigator [1972] 14 p Sponsored
by NASA
(E72-10253; NASA-CR-129130) Avail: NTIS HC \$3.00 CSCL
08F

The author has identified the following significant results. Accurate identification and delineation of crested wheatgrass seedlings has enabled a broad inventory of this resource. The entire state of Nevada is being inventoried for crested wheatgrass seedlings. Irrigated fields and pastures are easily visible from ERTS-1 imagery and were quantified in total acres on 12,500 square miles of the state. Recent fire scars may be monitored and inventoried from satellite-borne imagery. Inventory and quantification of large native meadows of Nevada have been accomplished on one frame of ERTS-1 data. This inventory would not have been economically feasible with any known ground inventory method. The U-2 sequential data taken in the spring revealed several resource management oriented phenological changes in the vegetation. The green-up of grasses and shrubs was detected on the imagery and supplied a good indicator for livestock turn-out dates. Water level manipulations in the Ruby Marsh were readily detected by noting changes in vegetation growth and reflectance.

**N73-12358*# Purdue Univ., Lafayette, Ind. Lab. for Application
of Remote Sensing.**

**PRELIMINARY RESULTS ON MACHINE CLASSIFICATION
OF SOIL ASSOCIATIONS IN COLLIN COUNTY, TEXAS**

David A. Landgrebe, Principal Investigator and Jan E. Cipra
30 Nov. 1972 1 p
(Contract NAS5-21773)
(E72-10260; NASA-CR-129184) Avail: NTIS HC \$3.00 CSCL
08M

01 AGRICULTURE AND FORESTRY

N73-12362* California Univ., Berkeley. Forestry Remote Sensing Lab.

THE USEFULNESS OF ERTS-1 AND SUPPORTING AIRCRAFT DATA FOR MONITORING PLANT DEVELOPMENT IN RANGELAND ENVIRONMENTS

D. M. Carnegie and S. D. DeGloria 21 Sep. 1972 3 p Presented at 8th Symp. on Remote Sensing of Environment, Ann Arbor, Mich., 8 Oct. 1972 Sponsored by NASA (E72-10283; NASA-CR-129225) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. Preliminary analysis of ERTS-1 MSS imagery of annual and perennial rangeland in California yields the following observations:

(1) Sufficient geomorphological detail can be resolved to differentiate upland and bottomland range sites in the foothill range areas. (2) Dry and green meadowland can be differentiated on MSS band 5. (3) Color composites prepared by NASA-Goddard were useful for locating perennial rangeland with varying amounts of herbaceous ground cover. (4) The ERTS-1 images received and interpreted cover nearly 50% of the state of California and show nearly two-thirds of the annual grassland type. (5) Satellite imagery obtained during the late summer season should be optimum for differentiating grassland from brushland and forested land. (6) The ERTS-1 imagery clearly shows areas which at one time were part of the annual grassland, but which are now used for dry land farming (cropping of cereal grains). Similarly, the imagery show areas which have been converted from brushland to grassland.

N73-12363* California Univ., Berkeley. Forestry Remote Sensing Lab.

APPLICATIONS OF ERTS-1 IMAGERY TO AGRICULTURAL RESOURCE EVALUATION

William C. Draeger and Andrew S. Benson 21 Sep. 1972 2 p Presented at 8th Symp. on Remote Sensing of Environment, Ann Arbor, Mich., 8 Oct. 1972 Sponsored by NASA (E72-10284; NASA-CR-129228) Avail: NTIS HC \$3.00 CSCL 02B

N73-12368* Bureau of Land Management, Riverside, Calif. PREDICT EPHEMERAL AND PERENNIAL RANGE QUANTITY AND QUALITY DURING NORMAL GRAZING SEASON Progress Report, 1 Sep. - 31 Oct. 1972

Gordon Bentley, Principal Investigator 27 Nov. 1972 4 p (NASA Order S-70243-AG-1) (E72-10289; NASA-CR-129231) Avail: NTIS HC \$3.00 CSCL 08M

N73-12403 Reading Univ. (England). Dept. of Agriculture. AGRICULTURAL APPLICATIONS OF SIDE-LOOKING RADAR

E. H. Roberts In Elliott-Automation Space and Advan. Mil. Systems Side-looking Radar Systems and their potential Appl. to Earth Resource Surveys, Vol. 32 Aug. 1972 p 8-20 refs

The possible uses of SLR in agriculture are considered in relation to other sensors. The present status of experiments SLR is considered with regard to crop recognition and potential applications, such as studies of crop growth and plant diseases. Recommendations for an experimental program are outlined.

Author (ESRO)

N73-12404 Reading Univ. (England). FORESTRY APPLICATIONS OF SIDE-LOOKING RADAR J. F. Hughes In Elliott-Automation Space and Advan. Mil. Systems Side-looking Radar Systems and their potential Appl. to Earth Resource Surveys, Vol. 3 Aug. 1972 p 21-41 refs

The present and future uses of SLR in forestry management are reviewed by comparison with aerial photography. SLR was used for general mapping and stratification of forest types, and other potential applications such as conservation, and timber inventory, and growth, are discussed. An experimental program of SLR in forestry is proposed.

Author (ESRO)

N73-12448* Honeywell, Inc., St. Paul, Minn. Systems and Research Div.

AUTOMATIC PHOTOINTERPRETATION FOR PLANT SPECIES AND STRESS IDENTIFICATION (ERTS-A1) Progress Report

George D. Swanlund, Principal Investigator and L. Kirvada 20 Nov. 1972 2 p

(Contract NAS5-2186) (E72-10258; NASA-CR-129190; FO175-PR1) Avail: NTIS HC \$3.00 CSCL 14E

N73-13070 Iowa State Univ. of Science and Technology, Ames. REMOTE DETECTION OF MOISTURE STRESS: FIELD AND LABORATORY EXPERIMENTS Ph.D. Thesis

Richard Eugene Carlson 1971 105 p Avail: Univ. Microfilms Order No. 72-5184

The relationship between the spectral properties of leaves and the water status of leaves from three crop species was studied under laboratory conditions. The wavelengths region examined was from 800 to 2,600 millimicrons. Leaf reflectivity and leaf absorptivity were highly correlated with relative leaf water content. The relationship between leaf transmissivity and relative leaf water content was variable with wavelength. Leaf transmissivity was, however, highly correlated with leaf specific densities. Relative leaf water content was estimated from leaf reflectivity. The estimates were improved if leaf transmissivity was included in the regression equation. In field experiments leaf temperature was significantly affected by relative leaf water content, air temperature, and vapor pressure deficit. A relative leaf water content by vapor pressure deficit interaction term was shown to affect leaf temperature. Air temperature affected leaf temperature by modifying stomatal conductivities and, hence, the leaf transpiration rate.

Dissert. Abstr.

N73-13151* Commonwealth Scientific and Industrial Research Organization, Melbourne (Australia). Div. of Applied Chemistry. A RADAR STUDY OF THE SMOKE PLUME FROM A FOREST FIRE

D. G. Reid and R. G. Vines 1972 14 p refs (Div.-Appl.-Chem.-TP-2) Avail: NTIS HC \$3.00

The development of the smoke cloud from a summer wildfire in a forest area was studied on a radar screen. In conjunction with photographs taken at the same time, it has been possible to follow the variations in height of both the top and bottom of the smoke column as it was blown downwind; estimates of the rate of rise of the smoke, at different heights, were also obtained. The general behavior of the smoke cloud is interpreted in terms of the prevailing winds and the lapse rate in the surrounding air.

Author

N73-13338* California Univ., Riverside. Dept. of Plant Science. EVALUATION OF REMOTE SENSING IN CONTROL OF PINK COTTON BOLLWORM Semiannual Report, Jul. - Nov. 1972 Lowell N. Lewis, Principal Investigator and Virginia B. Coleman 13 Dec. 1972 19 p ref (Contract NAS5-21771) (E72-10285; NASA-CR-129274; Rept-1) Avail: NTIS HC \$3.00 CSCL 02B

The author has identified the following significant results. This investigation is attempting to evaluate the use of a satellite in monitoring the cotton production regulation program of the State of California as an aid in controlling pink bollworm infestation in the southern deserts of California. Color combined images of ERTS-1 multispectral images simulating color infrared are being used in crop identification. The status of each field is mapped from the imagery and is then compared to ground surveys taken at the time of each ERTS-1 overflight. Correlation has been to date 100%. A computer analysis will be performed to compare field status with the crop calendar in order to identify crops. Correlation is expected to be 80 to 90%. Cotton fields, because of their state regulated season which is exactly coincident with no other crop, are expected to be easily identified.

01 AGRICULTURE AND FORESTRY

N73-13343*# Bureau of Sport Fisheries and Wildlife, Washington, D.C.

AN EVALUATION OF SPACE ACQUIRED DATA AS A TOOL FOR MANAGEMENT OF WILDLIFE HABITAT IN THE STATE OF ALASKA Progress Report, 1 Sep. - 31 Oct. 1972

Billy J. VanTries, Principal Investigator 1 Nov. 1972 3 p

(NASA Order S-70243-AG-1)

(E72-10293; NASA-CR-129285) Avail: NTIS HC \$3.00 CSCL 08F

N73-13351*# Natural Resources Management Corp., Berkeley, Calif. Research and Development Div.

INVESTIGATION OF THE DETECTION AND MONITORING OF FOREST INSECT INFESTATIONS IN THE SIERRA NEVADA MOUNTAINS OF CALIFORNIA Progress Report, 20 Jun. - 30 Nov. 1972

Ralph C. Hall, Principal Investigator 30 Nov. 1972 10 p

(Contract NAS5-21770)

(E72-10301; NASA-CR-129550) Avail: NTIS HC \$3.00 CSCL 02F

The author has identified the following significant results. Due to the fact that all of the ERTS-1 imagery has not been received, evaluation of this imagery will be delayed until all of it is at hand. It has been determined that the arbitrary classification of tree mortality into dead, dying, and light damage is sound in that each class is significantly different in terms of number and volume of trees killed. It has likewise been determined that the different classes of defoliation of light, medium, and heavy are significantly different in terms of the needles per tip. It has been found that all classes of tree mortality and degrees of defoliation are readily and accurately identified from underflight photos in color and color IR in both scales of 1/5000 and 1/18,500. Evaluation of U-2 imagery is incomplete. It has been determined, however, that through the use of RC-10 color IR it is expected to be able to detect all three classes of tree mortality and probably at least two extreme levels of defoliation.

N73-13360*# Direccion de Cartografia Nacional, Caracas (Venezuela).

DEVELOPMENT OF TECHNIQUES TO SIMPLIFY THE PROCESS OF INVESTIGATION AND ESTIMATE OF NATURAL RESOURCES IN REMOTE AND RELATIVELY UNEXPLORED AREAS Preliminary Report, Apr. 1971 - Jun. 1972

Adolfo C. Romero, Principal Investigator Sep. 1972 15 p

Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(E72-10311; NASA-CR-129560) Avail: NTIS HC \$3.00 CSCL 08G

N73-13361*# Mississippi State Univ., State College. Inst. for Environmental Studies

APPLICATION OF ERTS-A DATA TO AGRICULTURAL PRACTICES IN THE MISSISSIPPI DELTA REGION Progress Report, period ending 30 Nov. 1972

C. W. Bouchillon, Principal Investigator 8 Dec. 1972 5 p

(Contract NAS5-21881)

(E72-10312; NASA-CR-129561) Avail: NTIS HC \$3.00 CSCL 02C

N73-13363*# Arizona Univ., Tucson.

A STUDY TO EXPLORE THE USE OF ORBITAL REMOTE SENSING TO DETERMINE NATIVE ARID PLANT DISTRIBUTION Progress Report, period ending 17 Dec. 1972

William G. McGinnies, Principal Investigator 17 Dec. 1972 2 p

(Contract NAS5-21812)

(E72-10314; NASA-CR-129563) Avail: NTIS HC \$3.00 CSCL 08F

N73-13367*# Arizona Univ., Tucson. Dept. of Biological Sciences.

DETERMINATION OF SPECIES Bimonthly Report

Charles H. Lowe, Principal Investigator and Dana M. Slaymaker 20 Dec. 1972 2 p

(Contract NAS5-21819)

(E72-10318; NASA-CR-129576; BMR-1) Avail: NTIS HC \$3.00 CSCL 08F

N73-13368*# Tennessee Univ., Knoxville.

UTILIZATION OF ERTS DATA TO DETECT PLANT DISEASES AND NUTRIENT DEFICIENCIES, SOIL TYPES AND MOISTURE LEVELS Progress Report

W. L. Parks, J. I. Sewell, Principal Investigators, J. W. Hilty, and J. C. Rennie 27 Dec. 1972 4 p

(Contract NAS5-21873)

(E72-10320; NASA-CR-129578; PR-1) Avail: NTIS HC \$3.00 CSCL 08M

The author has identified the following significant results. A significant finding is the identification and delineation of a large soil association in Obion County, West Tennessee. These data are now being processed through the scanner and computer and will be included in the next report along with pictures of printout and imagery. Channel 7 appears to provide the most useful imagery related to soil differences. Soil types have been identified through the use of aircraft imagery. However, a soil association map appears to be the best that space imagery will provide. The exception to this will be large areas of a uniform soil type as occurs in the great plains.

N73-14323*# Iowa State Univ. of Science and Technology, Ames. Agriculture Experiment Station.

REMOTE SENSING IN IOWA AGRICULTURE Progress Report, period ending 31 Dec. 1972

John P. Mahlstede, Principal Investigator 2 Jan. 1973 4 p refs

(Contract NAS5-21839)

(E72-10335; NASA-CR-129649) Avail: NTIS HC \$3.00 CSCL 02C

The author has identified the following significant results. After receiving the ERTS-1 imagery, three methods of analysis of this imagery have been used. Observations noted are as follows: (1) Use of color additive and density slicing-color coding appears potentially useful for crop identification and automatic classification in Iowa for this time frame. The influence of soil association differences on the spectral response of the imagery will probably have to be taken into account for any automatic crop identification procedure to be successful. Small fields and the diversity of Iowa's cropping patterns also will cause significant problems for crop classifications. (2) The presence of high clouds and associated hazy atmospheric conditions markedly reduces the resolution of the ERTS-1 imagery. (3) Utilization of filtered 2 1/2 inch projectors is quite difficult because of multiple image registration problems. This procedure does, however, allow the interpreter to achieve image enlargement and the enhancement of response differences using two image projections.

N73-14324*# Department of Agriculture, Washington, D.C. **CROP IDENTIFICATION AND ACREAGE MEASUREMENT UTILIZING ERTS IMAGERY** Progress Report, 19 Jun. - 19 Dec. 1972

Donald H. VonSteen, Principal Investigator 19 Dec. 1972 13 p

(NASA Order S-70251-AG-3)

(E72-10336; NASA-CR-129650) Avail: NTIS HC \$3.00 CSCL 02C

N73-14334*# Alaska Univ., College.

APPLICATION OF ERTS-1 IMAGERY TO THE STUDY OF CARIBOU MOVEMENTS AND WINTER DISPERSAL IN RELATION TO PREVAILING SNOWCOVER Bimonthly Progress Report

Peter C. Lent, Principal Investigator 30 Nov. 1972 6 p

(Contract NAS5-21833)

01 AGRICULTURE AND FORESTRY

(E72-10346; NASA-CR-129660; BMPR-2) Avail: NTIS HC \$3.00 CSCL 02E

The author has identified the following significant results. Habitat differentiation was determined feasible using output from MSS band 6 because of apparent high correlations between surface moisture and habitat type on the test area. Progressive early snow distribution was readily determined from MSS outputs, particularly bands 4 and 5. Approximately thirty thousand caribou migrated into the test area during the reporting period, and aerial reconnaissance data on distribution were obtained for selected areas within several days of satellite overflight.

N73-14339*# Cornell Univ., Ithaca, N.Y.
PHENOLOGY SATELLITE EXPERIMENT Progress Report, 8 Oct. - 8 Dec. 1972
Bernard E. Dethier, Principal Investigator 8 Dec. 1972 3 p refs
(Contract NAS5-21781)
(E72-10351; NASA-CR-129664) Avail: NTIS HC \$3.00 CSCL 08F

N73-14344*# Idaho Univ., Moscow. Coll. of Forestry, Wildlife and Range Sciences.
APPLICATION OF REMOTE SENSING IN THE STUDY OF VEGETATION AND SOILS IN IDAHO
E. W. Tisdale, Principal Investigator 4 Jan. 1973 1 p
(Contract NAS5-21850)
(E72-10356; NASA-CR-129689) Avail: NTIS HC \$3.00 CSCL 08F

N73-14348*# Oregon State Univ., Corvallis.
INVENTORY AND MONITORING OF NATURAL VEGETATION AND RELATED RESOURCES IN AN ARID ENVIRONMENT BY THE USE OF ERTS-A IMAGERY Progress Report, 1 Nov. - 31 Dec. 1972
Barry J. Schrupf, Principal Investigator 31 Dec. 1972 4 p ref
(Contract NAS5-21831)
(E72-10360; NASA-CR-129722; PR-2) Avail: NTIS HC \$3.00 CSCL 08F

N73-14352*# Agricultural Research Service, Weslaco, Tex.
REFLECTANCE OF VEGETATION, SOIL, AND WATER Progress Report, 19 Jun. - 19 Dec. 1972
Craig L. Wiegand, Principal Investigator Jan. 1973 23 p refs
(NASA Order S-70251-AG)
(E72-10364; NASA-CR-129724) Avail: NTIS HC \$3.25 CSCL 17H

There are no author-identified significant results in this report. This report deals with the selection of the best channels from the 24-channel aircraft data to represent crop and soil conditions. A three-step procedure has been developed that involves using univariate statistics and an F-ratio test to indicate the best 14 channels. From the 14, the 10 best channels are selected by a multivariate stochastic process. The third step involves the pattern recognition procedures developed in the data analysis plan. Indications are that the procedures in use are satisfactory and will extract the desired information from the data.

N73-14357*# South Dakota State Univ., Brookings.
EFFECTIVE USE OF ERTS MULTISENSOR DATA IN THE GREAT PLAINS Progress Report, period ending 30 Nov. 1972
Victor I. Myers, Principal Investigator 30 Nov. 1972 17 p
Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
(Contract NAS5-21774)
(E72-10369; NASA-CR-129802) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. One unique advantage of ERTS imagery for delineating soil associations is the large area that can be scanned with one photo. Although soil associations usually are published at scales of 1:500,000 or 1:1,000,000, the delineations are drawn on much larger scale maps covering small pieces of the scene and then pieced together. Alluvial areas are usually swollen out of proportion to other soil areas. ERTS imagery puts alluvial areas into their proper size. A second feature of ERTS imagery is that a soil association map constructed with its aid assures that the cartographic level of the associations is more nearly the same. Another advantage of ERTS imagery is that the actual shape and configuration of soil associations are apparent. Also with ERTS imagery significant new delineations may become apparent which were missed when constructing soil association maps from conventional large scale photos.

N73-15090*# Smithsonian Institution, Washington, D.C.
SATELLITE (IRLS) TRACKING OF ELK Final Report
Helmut K. Buechner 11 Oct. 1972 21 p refs
(Contract NASw-1983)
(NASA-CR-130301) Avail: NTIS HC \$3.25 CSCL 08C

The practicability of tracking free roaming animals in natural environments by satellite systems is reported. Satellite systems combine continuous tracking with simultaneous monitoring of physiological and environmental parameters through a combination of radio tracking and biotelemetric ground systems that lead to a better understanding of animal behavior and migration patterns. G.G.

N73-15355*# Nevada Univ., Reno. Div. of Renewable Natural Resources.
USE OF SATELLITE IMAGERY FOR WILDLAND RESOURCE EVALUATION Progress Report, Dec. 1972 - Jan. 1973
Paul T. Tueller, Principal Investigator 15 Jan. 1973 9 p
(Contract NAS5-21870)
(E73-10019; NASA-CR-129945) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. Crested wheatgrass seedings have been quantified for the state of Nevada, and have been broken down by county and land status. The wide coverage of ERTS-1 has been found to be extremely useful for putting these seeded areas in the proper perspective for inventory. In the same manner, water bodies are being inventoried and changes relating to time are being monitored. Water resources are critical in Nevada, and this should prove useful to land owners and land managers throughout the state.

N73-15362*# Minnesota State Planning Agency, St. Paul.
APPLICATION OF ERTS-1 IMAGERY TO STATE WIDE LAND INFORMATION SYSTEM IN MINNESOTA Progress Report, Jul. - Dec. 1972
Joseph E. Sizer and John R. Borchert, Principal Investigators 15 Jan. 1973 18 p
(Contract NAS5-21801)
(E73-10029; NASA-CR-129984) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. To update and refine existing state-wide land resource information systems, the Minnesota State Planning Agency is assessing the feasibility of extracting resource information from ERTS-1 imagery. Work has centered on a comparative analysis of Minnesota Land Management Information System (MLMIS) and ERTS-1 land use classes. The associated problems of determining appropriate data cell size and optimal seasonal timing have also been addressed. Using ERTS-1 images, dominant land use is classified as follows: urban, forest, agriculture, extractive, transportation, water, and wetlands. Preliminary analysis suggests that with appropriate changes in operational definitions these general classes can be further refined for the benefit of MLMIS users. Additional detail appears most feasible extractive classes.

N73-15645* Wisconsin Univ., Madison. Dept. of Agronomy.
**APPENDIX. SOUTHERN CORN LEAF BLIGHT ADDENDUM
 TO THE CASE STUDY: IMPACT ON CORN PRODUCTION
 FROM RECENT ADVANCES IN SATELLITE METEOROLOGY**
 R. H. Andrew *In its Multidisciplinary Studies of the Social,
 Econ. and Political Impact Resulting from Recent Advan. in
 Satellite Meteorol.*, Vol. 4 Aug. 1972 p 193-199

The use of satellite meteorology to detect southern corn
 leaf blight is discussed. Specific data cover economic impact of
 improved forecasting on chemical control, sanitation procedures,
 production plans, and alternate uses and harvest of the corn
 crops. E.H.W.

N73-16064* National Aeronautics and Space Administration,
 Washington, D.C.

**RESULTS OF THE 1971 CORN BLIGHT WATCH EXPERI-
 MENT**

Robert B. MacDonald, Richard D. Allen (Dept. of Agr.), Marvin
 E. Bauer (Purdue Univ.), Joseph W. Clifton (Dept. of Agr.), Jon
 D. Frickson (Mich. Univ.), and David A. Landgrebe (Purdue Univ.)
 Lafayette, Ind. Purdue Univ. [1972] 34 p refs Presented at
 8th Intern. Symp. on Remote Sensing of Environment, Ann Arbor,
 Mich., 26 Oct. 1972 Prepared in cooperation with Purdue Univ.,
 Lab. for Applications of Remote Sensing
 (Grant NGL-15-005-112)

(NASA-TM-X-69055; LARS-Print-100272) Avail: NTIS HC
 \$3.75 CSCL 02C

Advanced remote sensing techniques are used to: (1) Detect
 development and spread of corn leaf blight during the growing
 season; (2) assess the extent and severity of blight infection;
 (3) assess the impact of blight on corn production; and (4)
 estimate the applicability of these techniques to similar situations
 occurring in the future. Author

N73-16302* Purdue Univ., Lafayette, Ind.
**IDENTIFICATION OF CROP SPECIES BY COMPUTER
 PROCESSING OF ERTS-1 MSS DATA**

31 Jan. 1973 2 p
 (E73-10039; NASA-CR-130299) Avail: NTIS HC \$3.00 CSCL
 08F

N73-16323* Bureau of Land Management, Riverside, Calif.
**PREDICT EPHEMERAL AND PERENNIAL RANGE QUANTI-
 TY AND QUALITY DURING NORMAL GRAZING SEASON**
 Progress Report, 1 Nov. - 31 Dec. 1972

Gordon Bentley, Principal Investigator 2 Jan. 1973 3 p refs
 (NASA Order S-70243-AG-1)
 (E73-10061; NASA-CR-130311) Avail: NTIS HC \$3.00 CSCL
 08B

N73-16327* Bureau of Sport Fisheries and Wildlife, Jamestown,
 N.D. Northern Prairie Wildlife Research Center.

**APPRAISING CHANGES IN CONTINENTAL MIGRATORY
 BIRD HABITAT** Progress Report, 1 Jul. - 31 Dec. 1972

Harvey K. Nelson, Principal Investigator 1 Jan. 1973 4 p
 (NASA Order S-70243-AG)
 (E73-10065; NASA-CR-130315) Avail: NTIS HC \$3.00 CSCL
 06C

N73-16330* Bureau of Land Management, Riverside, Calif.
 California Desert Planning Staff.

**PREDICT EPHEMERAL AND PERENNIAL RANGE QUAN-
 TITY AND QUALITY DURING NORMAL GRAZING SEASON**
 Progress Report, 1 Jul. - 1 Dec. 1972

Gordon Bentley, Principal Investigator 2 Jan. 1973 5 p
 (NASA Order S-70243-AG)
 (E73-10068; NASA-CR-130318) Avail: NTIS HC \$3.00 CSCL
 08F

There are no author-identified significant results in this
 report. Analysis of imagery made during the second and third
 2-month periods has yielded little usable information for the
 following reasons. Imagery taken of the deserts in Arizona and
 California and semi-arid southeastern Oregon has been of poor
 quality. Because of high reflectance of light from barren desert
 soils, imagery is over-exposed and positive transparencies are
 washed out. Imagery was also taken when plants were dormant
 so that differences in vegetation growth and development as
 exhibited by changes in tone of color infrared are nonexistent.

N73-16335* California Univ., Riverside. Citrus Research Center.
**EVALUATION OF REMOTE SENSING IN CONTROL OF PINK
 COTTON BOLLWORM**

Lowell N. Lewis, Principal Investigator and Virginia B. Coleman
 10 Feb. 1973 5 p

(Contract NAS5-21771)

(E73-10073; NASA-CR-130014) Avail: NTIS HC \$3.00 CSCL
 02A

The author has identified the following significant results.
 The U-2 underflight photography has shown that the critical
 stages in cotton plow down (defoliation, shredding, and plowing)
 can be identified. This result will prove invaluable to a user
 agency whose purpose is to monitor the cotton season for
 compliance with California State law.

N73-16337* Mississippi State Univ., State College. Inst. for
 Environmental Studies.

**APPLICATION OF ERTS-A DATA TO AGRICULTURAL
 PRACTICES IN THE MISSISSIPPI DELTA REGION** Progress
 Report

C. W. Bouchillon, Principal Investigator 8 Feb. 1973 5 p
 (Contract NAS5-21881)

(E73-10075; NASA-CR-130016; PR-2) Avail: NTIS HC
 \$3.00 CSCL 02C

N73-16338* South Dakota State Univ., Brookings. Remote
 Sensing Inst.

**EFFECTIVE USE OF ERTS MULTISENSOR DATA IN THE
 GREAT PLAINS** Progress Report, period ending 31 Jan.
 1973

Victor I. Myers, Principal Investigator 31 Jan. 1973 4 p
 (Contract NAS5-21774)

(E73-10076; NASA-CR-130017) Avail: NTIS HC \$3.00 CSCL
 08F

The author has identified the following significant results. It
 appears that identification of corn and soybeans as separate
 classes may not be feasible for the part of the growing season
 around August 15. It is hoped that at other points in the growing
 season separation of corn from soybeans will be possible. Visual
 examination of September 5 imagery indicates that later in the
 growing season, it is possible. The resolution of the 1:300,000
 scale enlargement remained sharp enough to distinguish features
 important for making soil association maps. The land use pattern
 (range vs cultivated) was sharp as were the stream bottoms,
 stream valley sides, and stock ponds. The resolution of the
 1:1,000,000 scale enlargement was less sharp on detail but it
 appears that some features could be quantitatively analyzed.
 Among these are the hydrologic features present such as stock
 ponds and the streams. It would appear that the total area of
 stock pond water on a frame could be measured, and, after
 ground truth established their average depth, the volume of water
 stored could be calculated and be monitored.

N73-16355* California Univ., Los Angeles.

**APPLICATIONS OF REMOTE SENSING IN AGRICULTURE
 AND FORESTRY**

Robert N. Colwell *In NASA, Washington Intern. Workshop on
 Earth Resources Surv. Systems*, Vol. 1 1972 p 67-90 refs

CSCL 02F

The rationale for remote sensing of agricultural and forest
 resources is presented. The user requirements for information

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on agricultural and forest resources are examined. The procedures to be followed in conducting a resources inventory are described. The advantages of aerial and space photography for evaluating resources are analyzed. Specific examples of resource analysis are included. Author

N73-16365* Comissao Nacional de Atividades Espaciais, Sao Jose Dos Campos (Brazil).

REMOTE SENSING IN THE ECONOMIC MANAGEMENT OF COFFEE PRODUCTION AND MARKETING

Marcos H. Velloso /In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 1 1972 p 195-199

CSCL 02B

Experiments were conducted to test the effectiveness of color photography and infrared photography in the detection of different degrees of defoliation in a coffee crop following a severe frost attack. The relationship between defoliation and production recovery is described. The logic of a program for automatic analysis and mapping of frost damage is outlined and its use in production prediction is described. Author

N73-16366* Comissao Nacional de Atividades Espaciais, Sao Jose Dos Campos (Brazil).

THE USE OF REMOTE SENSING IN THE DETECTION OF COFFEE LEAF RUST (HEMILEIA VASTATRIX)

Marcos H. Velloso /In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 1 1972 p 201-202

CSCL 02C

The detection of Hemileia in coffee using color photography and infrared photography was conducted. Work methodology is described and the form of analysis is outlined. The use of haze filters for high altitude photography of coffee crops are recommended. The effectiveness of the color scale for detecting foliage defects is analyzed. Author

N73-16369* Physical Research Lab., Ahmedabad (India).

REMOTE SENSING IN INDIA

P. R. Pisharoty /In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 1 1972 p 215-218 refs

CSCL 08F

A remote sensing project for the early detection of a wilt root disease affecting coconut palms in India is described. The construction of an infrared scanning camera is described. Data are presented in the form of a graph to show the intensity measurements for three conditions of palm trees. Author

N73-16383* California Univ., Berkeley. Forestry Remote Sensing Lab.

THE USE OF SMALL SCALE AERIAL PHOTOGRAPHY IN A REGIONAL AGRICULTURAL SURVEY

William C. Draeger /In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 2 14 May 1971 p 2-12 refs

CSCL 14E

The feasibility of performing inventories of agricultural resources using very small scale aerial or space photography has been investigated. Results to date are encouraging on two counts: (1) the questions posed initially are being answered, and (2) it would seem that a fully operational agricultural inventory using very small scale photography is not beyond the scope of present technology. The biggest problems to be faced in establishing a functional inventory system are those concerning logistics and data handling. Author

N73-16384* Agricultural Research Service, Weslaco, Tex. Soil and Water Conservation Research Div.

PHOTOGRAPHIC REMOTE SENSING OF SICK CITRUS TREES

Harold W. Gausman /In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 2 1971 p 14-30 refs

CSCL 02C

Remote sensing with infrared color aerial photography (Kodak Ektachrome Infrared Aero 8443 film) for detecting citrus tree anomalies is described. Illustrations and discussions are given for detecting nutrient toxicity symptoms, for detecting foot rot and sooty mold fungal diseases, and for distinguishing among citrus species. Also, the influence of internal leaf structure on light reflectance, transmittance, and absorptance are considered; and physiological and environmental factors that affect citrus leaf light reflectance are reviewed briefly and illustrated. Author

N73-16385* California Univ., Berkeley. Forestry Remote Sensing Lab.

TESTING MULTIBAND AND MULTIDATE PHOTOGRAPHY FOR CROP IDENTIFICATION

D. T. Lauer /In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 2 1971 p 32-46 refs

CSCL 02D

Procedures used and results derived in a series of prerequisite interpretation tests that were performed on multiband and multidate photography are described. The results of these quantitative tests led to the selection of what was considered to be the best combination of multiband and multidate photographs for use in the Maricopa County Survey. Author

N73-16387* Agricultural Research Service, Weslaco, Tex. Soil and Water Conservation Research Div.

AGRICULTURAL APPLICATIONS AND REQUIREMENTS FOR THERMAL INFRARED SCANNERS

Craig L. Wiegand /In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 2 1971 p 66-81 refs

CSCL 02C

Some of the applications of thermal scanner data in agriculture are presented along with illustrations of some of the factors affecting the temperature of plants, soil, and water. Examples of thermal imagery are included. Author

N73-16388* Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.

FOREST AND RANGE INVENTORY AND MAPPING

Robert C. Aldrich /In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 2 1971 p 82-106 refs

CSCL 08B

The state of the art in remote sensing for forest and range inventories and mapping has been discussed. There remains a long way to go before some of these techniques can be used on an operational basis. By the time that the Earth Resources Technology Satellite and Skylab space missions are flown, it should be possible to tell what kind and what quality of information can be extracted from remote sensors and how it can be used for surveys of forest and range resources. Author

N73-16389* Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.

DETECTION AND CHARACTERIZATION OF STRESS SYMPTOMS IN FOREST VEGETATION

Robert C. Heller /In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 2 1971 p 108-150 refs

CSCL 02F

Techniques used at the Pacific Southwest Forest and Range Experiment Station to detect advanced and previsual symptoms of vegetative stress are discussed. Stresses caused by bark beetles in coniferous stands of timber are emphasized because beetles induce stress more rapidly than most other destructive agents. Bark beetles are also the most damaging forest insects in the United States. In the work on stress symptoms, there are two primary objectives: (1) to learn the best combination of films, scales, and filters to detect and locate injured trees from aircraft and spacecraft, and (2) to learn if stressed trees can be detected before visual symptoms of decline occur. Equipment and techniques used in a study of the epidemic of the Black Hills bark beetle are described. Author

N73-16390* Northern Forest Fire Lab., Missoula, Mont.
APPLICATION OF INFRARED SCANNERS TO FOREST FIRE DETECTION c14

Stanley N. Hirsch /in NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 2 1971 p 152-169 refs

(Proj. Fire Scan)

CSCL 02F

The potential of using infrared scanners for the detection of forest fires is discussed. An experiment is described in which infrared and visual detection systems were used jointly to study timber fire detection. Many fires were detected visually but missed by the airborne IR system, and many fires were detected by the IR system but missed visually. Until more is learned about the relationship between heat output and smoke output from latent fires, the relative effectiveness of visual and IR systems cannot be determined. The 1970 tests indicated that IR used in combination with visual detection will result in a more efficient system than visual alone. Even with limited knowledge of the relative effectiveness of the two systems, operational use of a combined system can be used to substantially reduce total firefighting costs. A.L.

N73-16396* Geological Survey, Washington, D.C.
APPLICATION OF REMOTE SENSING TECHNIQUES FOR APPRAISING CHANGES IN WILDLIFE HABITAT c04

Harvey K. Nelson (Northern Prairie Wildlife Res. Center), A. T. Klett (Northern Prairie Wildlife Res. Center), and John E. Johnston /in NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 2 1971 p 260-288 refs

CSCL 02E

An attempt was made to investigate the potential of airborne, multispectral, line scanner data acquisition and computer-implemented automatic recognition techniques for providing useful information about waterfowl breeding habitat in North Dakota. The spectral characteristics of the components of a landscape containing waterfowl habitat can be detected with airborne scanners. By analyzing these spectral characteristics it is possible to identify and map the landscape components through analog and digital processing methods. At the present stage of development multispectral remote sensing techniques are not ready for operational application to surveys of migratory bird habitat and other such resources. Further developments are needed to: (1) increase accuracy; (2) decrease retrieval and processing time; and (3) reduce costs. A.L.

N73-16406* Geological Survey, Tucson, Ariz.
MEASUREMENT OF SPATIAL AND TEMPORAL CHANGES IN VEGETATION FROM COLOR-IR FILM

Raymond M. Turner /in NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 2 1971 p 512-525 refs

CSCL 08F

The use of color infrared film to measure spatial and temporal changes in vegetation is discussed. The subjects presented are: (1) selection of the sensor, (2) collection of the data, and (3) analysis of the data. The effects of climatology and meteorological parameters on interpretation of the data are analyzed. It is concluded that the color infrared film will enhance the imagery of green plants and will accentuate differences between plants. Author

N73-16420* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

CHANGES OF MULTISPECTRAL SOIL PATTERNS WITH INCREASING CROP CANOPY

S. J. Kristof and M. F. Baumgardner [1972] 31 p refs (Grant NGL-15-005-112) (NASA-CR-130035; LARS-Print-102372; J-Paper-4927) Avail: NTIS HC \$3.75 CSCL 08M

Multispectral data and automatic data processing were used to map surface soil patterns and to follow the changes in multispectral radiation from a field of maize (*Zea mays* L.) during

a period from seeding to maturity. Panchromatic aerial photography was obtained in early May 1970 and multispectral scanner missions were flown on May 6, June 30, August 11 and September 5, 1970 to obtain energy measurements in 13 wavelength bands. The orange portion of the visible spectrum was used in analyzing the May and June data to cluster relative radiance of the soils into eight different radiance levels. The reflective infrared spectral band was used in analyzing the August and September data to cluster maize into different spectral categories. The computer-produced soil patterns had a striking similarity to the soil pattern of the aerial photograph. These patterns became less distinct as the maize canopy increased. Author

N73-16421* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

DETERMINING DENSITY OF MAIZE CANOPY. 3: TEMPORAL CONSIDERATIONS

E. R. Stoner, M. F. Baumgardner, P. E. Anuta, and J. E. Cipra [1972] 33 p refs

(Grant NGL-15-005-112)

(NASA-CR-130369; LARS-Print-111372; J-Paper-4931) Avail: NTIS HC \$3.75 CSCL 20C

Multispectral scanner data were collected in two flights over ground cover plots at an altitude of 305 m. Eight ground reflectance panels in close proximity to the ground cover plots were used to normalize the scanner data obtained on different dates. Separate prediction equations were obtained for both flight dates for all eleven reflective wavelength bands of the multispectral scanner. Ratios of normalized scanner data were related to leaf area index over time. Normalized scanner data were used to plot relative reflectance versus wavelength for the ground cover plots. Spectral response curves were similar to those for bare soil and green vegetation as determined by laboratory measurements. The spectral response curves from the normalized scanner data indicated that reflectance in the 0.72 to 1.3 micron wavelength range increased as leaf area index increased. A decrease in reflectance was observed in the 0.65 micron chlorophyll absorption band as leaf area index increased. Author

N73-16422* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

DETERMINING DENSITY OF MAIZE CANOPY. 1: DIGITIZED PHOTOGRAPHY

E. R. Stoner, M. F. Baumgardner, and P. H. Swain [1972] 28 p refs

(Grant NGL-15-005-112)

(NASA-CR-130370; LARS-Print-111172; J-Paper-4929) Avail: NTIS HC \$3.50 CSCL 14E

The relationship between different densities of maize (*Zea mays* L.) canopies and the energy reflected by these canopies was studied. Field plots were laid out, representing four growth stages of maize, on a dark soil and on a very light colored surface soil. Spectral and spatial data were obtained from color and color infrared photography taken from a vertical distance of 10 m above the maize canopies. Estimates of ground cover were related to field measurements of leaf area index. Ground cover was predicted from leaf area index measurements by a second order equation. Color infrared photography proved helpful in determining the density of maize canopy on light colored soils. The near infrared dye layer is the most valuable in canopy density determinations. Author

N73-16424* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

APPLICATION OF MULTISPECTRAL REMOTE SENSING TO SOIL SURVEY RESEARCH IN INDIANA

A. L. Zachary, J. E. Cipra, R. I. Diderickson, S. J. Kristof, and M. F. Baumgardner [1972] 13 p refs (Grant NGL-15-002-112)

(NASA-CR-130033; LARS-Print-110972) Avail: NTIS HC \$3.00 CSCL 08M

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Computer-implemented mappings based on spectral properties of bare soil surfaces were compared with mapping units of interest to soil surveyors. Some soil types could be differentiated by their spectral properties. In other cases, soils with similar surface colors and textures could not be distinguished spectrally. The spectral maps seemed useful for delineating boundaries between soils in many cases. Author

N73-16425* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

DETERMINING DENSITY OF MAIZE CANOPY. 2: AIRBORNE MULTISPECTRAL SCANNER DATA

E. R. Stoner, M. F. Baumgardner, and J. E. Cipra [1971] 17 p refs

(Grant NGL-15-005-112)

(NASA-CR-130363; LARS-Print-111272; J-Paper-4930) Avail: NTIS HC \$3.00 CSCL 14E

Multispectral scanner data were collected in two flights over a light colored soil background cover plot at an altitude of 305 m. Energy in eleven reflective wavelength band from 0.45 to 2.6 microns was recorded. Four growth stages of maize (Zea mays L.) gave a wide range of canopy densities for each flight date. Leaf area index measurements were taken from the twelve subplots and were used as a measure of canopy density. Ratio techniques were used to relate uncalibrated scanner response to leaf area index. The ratios of scanner data values for the 0.72 to 0.92 micron wavelength band over the 0.61 to 0.70 micron wavelength band were calculated for each plot. The ratios related very well to leaf area index for a given flight date. The results indicated that spectral data from maize canopies could be of value in determining canopy density. Author

N73-16428* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

INFLUENCE OF HAZE LAYERS UPON REMOTELY-SENSED SURFACE PROPERTIES

G. M. Jurica and W. L. Murray [1972] 8 p refs Presented at Conf. on Atmospheric Radiation, Fort Collins, Colo., 7-9 Aug. 1972

(Grant NGL-15-005-112)

(NASA-CR-130028; LARS-Print-060272) Avail: NTIS HC \$3.00 CSCL 08M

The possibility that the presence of hazy layers contributes to anomalous effects in airplane remote sensing data on corn blight distribution is studied. Computations of scattering angles along flightlines are used to estimate reflected intensity variations as observed in bright and dark sides along flightline of the aircraft. G.G.

N73-16434* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

DEFINITION OF SPECTRALLY SEPARABLE CLASSES FOR SOIL SURVEY RESEARCH

J. E. Cipra, P. H. Swain, J. H. Gill, M. F. Baumgardner, and S. J. Kristof [1972] 7 p refs Presented at 8th Intern. Symp. on Remote Sensing of Environment, Ann Arbor, Mich., 2-6 Oct. 1972

(Grant NGL-15-005-112)

(NASA-CR-130031; LARS-Print-100372) Avail: NTIS HC \$3.00 CSCL 08M

A procedure is outlined for defining spectral classes such that the differences between classes can be quantified. It also facilitates determination of a number of classes such that the classes are spectrally discriminable. This is accomplished by partitioning the data into many classes and then combining similar spectral classes on the basis of appropriate criteria. Multispectral data were collected over a 12-mile flightline in White County, Indiana, in connection with the 1971 Corn Blight Watch Experiment. Data were collected in May by the University of Michigan airborne scanning spectrometer at an altitude of 5000 feet. Spectral maps resulting from the analysis were compared to existing soil surveys of the National Cooperative Soil Survey. The method should help determine the extent to which spectral properties of soil surfaces can be associated with morphologic and topographic differences of interest to soil surveyors engaged in operational soil mapping. Author

N73-16435* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

AUTOMATIC CLASSIFICATION OF SOILS AND VEGETATION WITH ERTS-1 DATA

David A. Landgrebe 1972 10 p refs Presented at 23d Intern. Astronaut. Congr., Vienna, 14 Oct. 1972

(Contract NAS5-21773; Grant NGL-15-005-112)

(NASA-CR-130021; LARS-Print-101472) Avail: NTIS HC \$3.00 CSCL 08M

Preliminary results of a test of a computerized analysis method using ERTS 1 data are presented. The method consisted of a four-spectral-band supervised, maximum likelihood, Gaussian classifier with training statistics derived through a combination of clustering and manual methods. The multivariate analysis method leads to the assignment of each resolution element of the data to one of a preselected set of discrete classes. The data frame was an area over the Texas-Oklahoma border including Lake Texoma. The study suggests that multispectral scanner data coupled with machine processing shows promise for earth surface cover surveys. Furthermore, the processing time is short and consequently the costs are low; a full frame can be analyzed completely within 48 hours. N.E.N.

N73-17296* Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.

INVENTORY OF FOREST AND RANGELAND AND DETECTION OF FOREST STRESS Progress Report, 1 Jul. - 31 Dec. 1972

Robert C. Heller, Principal Investigator, Robert C. Aldrich, Frederick P. Weber, and Richard S. Driscoll 10 Jan. 1973 14 p

(NASA Order S-70251-AG)

(E73-10084; NASA-CR-130282; FS-2-1; PR-1) Avail: NTIS HC \$3.00 CSCL 02F

N73-17306* Geological Survey, Tucson, Ariz.

DYNAMICS OF DISTRIBUTION AND DENSITY OF PHREATOPHYTES AND OTHER ARID LAND PLANT COMMUNITIES Progress Report, 1 Jul. - 31 Dec. 1972

Raymond M. Turner, Principal Investigator 15 Jan. 1973 5 p

(NASA Order S-70243-AG-2)

(E73-10094; NASA-CR-130343) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. Ground truth measurements of plant coverage on six satellite overflight dates reveal unique trends in coverage for the five desert or semi-desert communities selected. Densitometry and multispectral additive color viewing were used in a preliminary analysis of imagery using the electronic satellite image analyzer console at Stanford Research Institute. The densitometric analysis shows promise for mapping boundaries between plant communities. Color additive viewing of a chronologic sequence of the same scene shown in rapid order will provide a method for mapping phreatophyte communities.

N73-17309* Centre for Overseas Pest Research, London (England).

TESTING FEASIBILITY OF DETECTING POTENTIAL LOCUST BREEDING SITES Progress Report, 23 Oct. 1972 - 22 Jan. 1973

D. E. Pedgley, Principal Investigator. 23 Jan. 1973 10 p Sponsored by NASA

(E73-10098; NASA-CR-130526) Avail: NTIS HC \$3.00 CSCL 06C

N73-17484* Alaska Univ., Palmer. Inst. of Agricultural Sciences.

IDENTIFICATION OF PHENOLOGICAL STAGES AND VEGETATIVE TYPES FOR LAND USE CLASSIFICATION Semiannual Report, Jul. 1972 - Jan. 1973

C. Ivan Branton, Principal Investigator and J. D. McKendrick 20 Feb. 1973 13 p

(Contract NAS5-21833)

(E73-10276; NASA-CR-130559) Avail: NTIS HC \$3.00 CSCL 08F

N73-17491*# Alaska Univ., Fairbanks. Alaska Cooperative Wildlife Research Unit.

APPLICATION OF ERTS-1 IMAGERY TO THE STUDY OF CARIBOU MOVEMENTS AND WINTER DISPERSAL IN RELATION TO PREVAILING SNOWCOVER Progress Report, Jul. 1972 - Jan. 1973

Peter C. Lent, Principal Investigator and Arthur J. Laperriere
20 Feb. 1973 12 p refs
(Contract NAS5-21833)

(E73-10285; NASA-CR-130568) Avail: NTIS HC \$3.00 CSCL 08C

N73-17935* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

SOIL MOISTURE MEASUREMENTS WITH MICROWAVE RADIOMETERS c14

Thomas J. Schmugge *In its* Significant Accomplishments in Sci., 1971 1972 p 3-6 Original contains color illustrations

CSCL 08M

Soil moisture measurements with microwave radiometers are used to study energy exchange of the air-soil interface. The Convair 990 was flown over agricultural test sites near Phoenix, Arizona to test remote sensors for soil moisture measurement. Onboard were six radiometers, ranging in wavelength from 21 cm to 8 mm. Linear regression results of microwave brightness temperature versus soil moisture content are shown. J.A.M.

N73-18329*# Forest Research Inst., Helsinki (Finland). **DEMONSTRATION OF THE APPLICABILITY OF SATELLITE DATA TO FORESTRY** Progress Report, Dec. 1972 - Feb. 1973

Kullervo Kuusela, Principal Investigator Feb. 1973 7 p Sponsored by NASA

(E73-10297; NASA-CR-130553) Avail: NTIS HC \$3.00 CSCL 02F

The author has identified the following significant results. The experiments made with aerial photos and satellite pictures showed that there are distinct correlations between tone values of satellite pictures and the volume of forest growing stock. Field work is regarded as necessary in order to draw more detailed conclusions.

N73-18334*# Texas A&M Univ., College Station. Remote Sensing Center.

MONITORING THE VERNAL ADVANCEMENT AND RETROGRADATION (GREEN WAVE EFFECT) OF NATURAL VEGETATION Progress Report, 27 Sep. - 27 Nov. 1972

J. W. Rouse, Jr., Principal Investigator 27 Nov. 1972 18 p ref

(Contract NAS5-21857)
(E73-10302; NASA-CR-130385; PR-1) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. The asserted homogeneity of the Great Plains Corridor was established, as evidenced from test site characteristic determinations. First-look visual analysis of ERTS-1 black and white images reveals the ability to locate network test sites. Geological formations associated with major vegetation types are readily apparent on the imagery. Grasslands are readily distinguishable from forested and cropped areas. Under magnification, pastures as small as five to ten acres can be recognized in areas of contrasting vegetation. Bodies of water (rivers, lakes, and large farm ponds) are easily located on bands 6 and 7. Urban areas and major highways are also easily observed and useful as landmarks.

N73-18335*# Texas A&M Research Foundation, College Station. Remote Sensing Center.

MONITORING THE VERNAL ADVANCEMENT AND RETROGRADATION (GREEN WAVE EFFECT) OF NATURAL VEGETATION Progress Report, 28 Nov. 1972 - 27 Jan. 1973

J. W. Rouse, Jr., Principal Investigator 27 Jan. 1973 12 p (Contract NAS5-21857)

(E73-10303; NASA-CR-130715; PR-2) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. Preliminary evaluation of autumnal phase ground truth data suggests that the sampling procedures at the Great Plains Corridor network test sites are adequate to show relatively small temporal changes in above-ground vegetation biomass and vegetation condition. Vegetation changes measured August through December, reflect grazing intensity and environmental conditions at the test sites. Preliminary analysis of black and white imagery suggests that detail in vegetation patterns is much greater than originally anticipated. A first look analysis of single band imagery and digital data at two locations shows that woodland, grassland, and cropland areas are easily delineated. Computer derived grey-scale maps from MSS digital data were shown to be useful in identifying the location of small fields and features of the natural and cultivated lands. Single band imagery and digital data are believed to have important application for synoptic land use mapping and inventory. Initial ratio analysis, using band 5 and 7 data, suggests the applicability in the greenness of a vegetative scene.

N73-18342*# Michigan State Univ., East Lansing.

USE OF ERTS DATA FOR A MULTIDISCIPLINARY ANALYSIS OF MICHIGAN RESOURCES Progress Report. Axel L. Anderson, Wayne Myers, Gene Safir, and S. P. Hiteside, Principal Investigators 20 Feb. 1973 14 p

(Contract NAS5-21834)
(E73-10310; NASA-CR-130728; PR-1) Avail: NTIS HC \$3.00 CSCL 08F

N73-18343*# Tennessee Univ., Knoxville. Dept. of Plant and Soil Science.

UTILIZATION OF ERTS DATA TO DETECT PLANT DISEASES AND NUTRIENT DEFICIENCIES, SOIL TYPES AND MOISTURE LEVELS Progress Report

W. L. Parks, J. I. Sewell, J. W. Hilty, and J. C. Rennie, Principal Investigators 2 Mar. 1973 5 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(Contract NAS5-21873)
(E73-10311; NASA-CR-130729; PR-2) Avail: NTIS HC \$3.00 CSCL 02D

N73-18344*# Natural Resources Management Corp., Berkeley, Calif. Research and Development Div.

INVESTIGATION OF THE DETECTION AND MONITORING OF FOREST INSECT INFESTATIONS IN THE SIERRA NEVADA MOUNTAINS OF CALIFORNIA Progress Report, 1 Dec. 1972 - 31 Jan. 1973

Ralph C. Hall, Principal Investigator 31 Jan. 1973 6 p (Contract NAS5-21770)

(E73-10312; NASA-CR-130730) Avail: NTIS HC \$3.00 CSCL 08C

The author has identified the following significant results. The detection of insect infestations through the use of ERTS-1 imagery alone is very promising. In the field of features other than insect infestation, it is possible to detect: timber vs. non-timber; timber density in broad categories; lakes, major stream courses, rock outcrops and domes; riparian vegetation, cultivated fields, pasture land, and glaciers.

N73-18351*# Bureau of Indian Affairs, Washington, D.C.

TIMBER RESOURCE INFORMATION SYSTEM Progress Report, 1 Jul. - 31 Dec. 1972

Arthur M. Woll, Principal Investigator Feb. 1972 3 p (NASA Order S-70243-AG-3)

(E73-10319; NASA-CR-130737) Avail: NTIS HC \$3.00 CSCL 02F

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N73-18355*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

EVALUATION AND COMPARISON OF ERTS MEASUREMENTS OF MAJOR CROPS AND SOIL ASSOCIATIONS FOR SELECTED SITES IN THE CENTRAL UNITED STATES

Semiannual Progress Report, Jul. - Dec. 1972
Marion F. Baumgardner, Principal Investigator 1 Jan. 1973 39 p
Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(Contract NAS5-21785)

(E73-10323; NASA-CR-130741) Avail: NTIS HC \$4.00 CSCL 02C

N73-18359*# Department of Agriculture, Washington, D.C. Statistical Reporting Service.

CROP IDENTIFICATION AND ACREAGE MEASUREMENT UTILIZING ERTS IMAGERY Progress Report, 20 Dec. 1972 - 19 Feb. 1973

Donald H. VonSteen, Principal Investigator 19 Feb. 1973 12 p
(NASA Order S-70251-AG-3)

(E73-10328; NASA-CR-130771) Avail: NTIS HC \$3.00 CSCL 02C

N73-18364*# Bureau of Sport Fisheries and Wildlife, Jamestown, N.D.

APPRAISING CHANGES IN CONTINENTAL MIGRATORY BIRD HABITAT Progress Report, 1 Jan. - 28 Feb. 1973

Harvey K. Nelson, Principal Investigator 1 Mar. 1973 3 p
(NASA Order S-70243-AG-4)

(E73-10334; NASA-CR-130784) Avail: NTIS HC \$3.00 CSCL 08C

N73-18376*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

AGRICULTURAL AND FOREST RESOURCE SURVEYS FROM SPACE

Roger M. Hoffer [1973] 13 p refs Presented at 23d Intern. Astronaut. Congr., Vienna, 8-15 Oct. 1972

(Grant NGL-15-005-112)

(NASA-CR-130798; LARS-100972) Avail: NTIS HC \$3.00 CSCL 02C

An overview is presented on the use of spaceborne remote sensors as aid to agriculture and forestry for soil mapping, crop yield predictions, acreage determinations, damage assessment, and numerous other benefits. Some results obtained by ERTS 1 are discussed in terms of the significance of information derived and the potential use of these data for better management of our natural resources. D.L.G.

N73-19336*# Bureau of Sport Fisheries and Wildlife, Washington, D.C.

AN EVALUATION OF ACQUIRED DATA AS A TOOL FOR MANAGEMENT OF WILDLIFE HABITAT IN ALASKA Progress Report, 1 Jan. - 28 Feb. 1973

Bill J. VanTries, Principal Investigator 1 Mar. 1973 3 p
(NASA Order S-70243-AG-1)

(E73-10335; NASA-CR-130785) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. Density sliced and digitized imagery of the Kuskokwin/Yukon Delta were analyzed. Color coded images of the isodensity displays were compared with existing vegetation maps of the ERTS-1 frames for the Yukon/Kuskokwin area. A high degree of positive correlation was found to exist between the ERTS-1 image and the conventionally prepared maps. Hydrologic phenomena were also analyzed. Digitization on South Dakota State Remote Sensing Center's SADE system provide some discrimination among several large lakes in the subject area. However, interpretation must await ground observations and depth measurements. An attempt will be made to classify large water bodies by depth classes.

N73-19337*# Bureau of Reclamation, Denver, Colo.

APPLICATION OF REMOTE SENSING TO SELECTED BUREAU OF RECLAMATION PROJECTS Progress Report, 1 Jan. - 28 Feb. 1973

Larry D. Cast, Principal Investigator 1 Mar. 1973 2 p
(NASA Order S-70243-AG)

(E73-10336; NASA-CR-130786) Avail: NTIS HC \$3.00 CSCL 14E

N73-19342*# Iowa State Univ. of Science and Technology, Ames. Agriculture Experiment Station.

REMOTE SENSING IN IOWA AGRICULTURE: IDENTIFICATION AND CLASSIFICATION OF IOWA CROP LAND USING ERTS-1 AND COMPLIMENTARY UNDERFLIGHT IMAGERY Semiannual Report, period ending Feb. 1973

R. E. Carlson and J. P. Mahlstede, Principal Investigators 14 Mar. 1973 13 p Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(Contract NAS5-21839)

(E73-10343; NASA-CR-130802) Avail: NTIS HC \$3.00 CSCL 20C

N73-19356*# Nebraska Univ., Lincoln.

SATELLITE IMAGERY FOR ASSESSING RANGE FIRE DAMAGE IN THE SANDHILLS OF NEBRASKA

James V. Drew, Principal Investigator, Paul M. Seevers, and Peter N. Jensen [1973] 11 p refs Submitted for publication Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(Contract NAS5-21756)

(E73-10360; NASA-CR-130975) Avail: NTIS HC \$3.00 CSCL 02F

The author has identified the following significant results. Initial imagery from the first ERTS indicates that satellite-acquired data is of value in determining the location and extent of range fire in the Sand Hills region of Nebraska. Preliminary results suggest that it can also provide a tool for monitoring soil erosion by wind and evaluating the recovery of vegetation in burned areas.

N73-19360*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

A STUDY OF THE UTILIZATION OF ERTS-1 DATA FROM THE WABASH RIVER BASIN Bimonthly Progress Report, 1 Jan. - 28 Feb. 1973

D. A. Landgrebe, Principal Investigator 28 Feb. 1973 3 p
(Contract NAS5-21773)

(E73-10364; NASA-CR-131005) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. Preliminary acreage estimates for corn, soybeans, and other cover types made from classification of ERTS-1 data compared well with those made by the U.S. Department of Agriculture. Registration of multiple frames of ERTS-1 CCT data over Lynn County, Texas and DeKalb County, Illinois was achieved to a high degree of accuracy. Spectral/temporal computer pattern recognition analysis was carried out for the first time using satellite data.

N73-19361*# Honeywell, Inc., St. Paul, Minn. Systems and Research Div.

AUTOMATIC PHOTOINTERPRETATION FOR PLANT SPECIES AND STRESS IDENTIFICATION (ERTS-A1) Progress Report

George D. Swanlund, Principal Investigator, Leonard Kirvida, and Greg R. Johnson 20 Mar. 1973 9 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(Contract NAS5-2186)

(E73-10365; NASA-CR-131006) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. Automatic stratification of forested land from ERTS-1 data provides a valuable tool for resource management. The results are useful for wood product yield estimates, recreation and wildlife management, forest inventory, and forest condition monitoring. Automatic procedures based on both multispectral and spatial features are evaluated. With five classes, training and testing on the same samples, classification accuracy of 74 percent was achieved using the MSS multispectral features. When adding texture computed from 8 x 8 arrays, classification accuracy of 90 percent was obtained.

N73-19362*# Honeywell, Inc., St. Paul, Minn. Systems and Research Div.

AUTOMATIC PHOTOINTERPRETATION FOR PLANT SPECIES AND STRESS IDENTIFICATION (ERTS-A1) Progress Report

George D. Swanlund, Principal Investigator and Leonard Kirvida
20 Jan. 1973 3 p

(Contract NAS5-2186)

(E73-10366; NASA-CR-131007; PR-2) Avail: NTIS HC \$3.00 CSCL 08F

N73-19365*# Arizona Univ., Tucson.

A STUDY TO EXPLORE THE USE OF ORBITAL REMOTE SENSING TO DETERMINE NATIVE ARID PLANT DISTRIBUTION Progress Report, period ending 16 Feb. 1973

William G. McGinnies, Principal Investigator, Edward F. Haase, and H. Brad Musick, comp. 16 Feb. 1973 28 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(Contract NAS5-21812)

(E73-10369; NASA-CR-131010) Avail: NTIS HC \$3.50 CSCL 08F

The author has identified the following significant results. A theory has been developed of a method for determining the reflectivities of natural areas from ERTS-1 data. This method requires the following measurements: (1) ground truth reflectivity data from two different calibration areas; (2) radiance data from ERTS-1 MSS imagery for the same two calibration areas; and (3) radiance data from ERTS-1 MSS imagery for the area(s) in which reflectivity is to be determined. The method takes into account sun angle effects and atmospheric effects on the radiance seen by the space sensor. If certain assumptions are made, the ground truth data collection need not be simultaneous with the ERTS-1 overflight. The method allows the calculation of a conversion factor for converting ERTS-1 MSS radiance measurements of a given overflight to reflectivity values. This conversion factor can be used to determine the reflectivity of any area in the general vicinity of the calibration areas which has a relatively similar overlying atmosphere. This method, or some modification of it, may be useful in ERTS investigations which require the determination of spectral signatures of areas from spacecraft data.

N73-19367*# Nebraska Univ., Lincoln.

PROPOSAL TO EVALUATE THE USE OF ERTS-A IMAGERY IN MAPPING AND MANAGING SOIL RANGE RESOURCES IN THE SAND HILLS REGION OF NEBRASKA Progress Report, 1 Jan. - 28 Feb. 1973

James V. Drew, Principal Investigator 22 Mar. 1973 9 p

(Contract NAS5-21756)

(E73-10372; NASA-CR-131013) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. Color composites generated from bands 4, 5, and 7 of MSS image 1061-16552 show that Aquic Haplustolls and Typic Haplaquolls can be separated from other subgroups present on Sand Hills rangeland. Since Aquic Haplustolls are suitable for establishment of center pivot irrigation systems, this provides one means of locating and assessing sites for the establishment of center pivot irrigation for irrigated pasture or other irrigated crops. This separation also provides for a rapid assessment of subirrigated land, much of which is used for harvest of hay. Subsequent estimates of hay production can then be made as ground truth establishes actual production levels.

N73-19372*# Bureau of Land Management, Riverside, Calif.
PREDICT EPHEMERAL AND PERENNIAL RANGE QUANTITY AND QUALITY DURING NORMAL GRAZING SEASON Progress Report, 1 Jan. - 28 Feb. 1973

Gordon Bentley, Principal Investigator 1 Mar. 1973 3 p

(NASA Order S-70243-AG-1)

(E73-10377; NASA-CR-131018) Avail: NTIS HC \$3.00 CSCL 08F

N73-19392*# South Dakota State Univ., Brookings. Remote Sensing Inst.

REFLECTANCE MEASUREMENTS FOR THE DETECTION AND MAPPING OF SOIL LIMITATIONS Interim Technical Report

L. A. Benson and C. J. Frazee Mar. 1973 93 p refs Original contains color illustrations

(Grant NGL-42-003-007)

(NASA-CR-131110; SDSU-RSI-73-04) Avail: NTIS HC \$6.75 CSCL 08M

During 1971 and 1972 research was conducted on two fallow fields in the proposed Oahe Irrigation Project to investigate the relationship between the tonal variations observed on aerial photographs and the principal soil limitations of the area. A grid sampling procedure was used to collect detailed field data during the 1972 growing season. The field data was compared to imagery collected on May 14, 1971 at 3050 meters altitude. The imagery and field data were initially evaluated by a visual analysis. Correlation and regression analysis revealed a highly significant correlation between the digitized color infrared film data and soil properties such as organic matter content, color, depth to carbonates, bulk density and reflectivity. Computer classification of the multiemulsion film data resulted in maps delineating the areas containing claypan and erosion limitations. Reflectance data from the red spectral band provided the best results.

Author

N73-19395*# South Dakota State Univ., Brookings. Remote Sensing Inst.

REMOTE SENSING OF PHYSIOGRAPHIC SOIL UNITS OF BENNETT COUNTY, SOUTH DAKOTA

C. J. Frazee, J. L. Gropper, and F. C. Westin Feb. 1973 46 p refs

(Grant NGL-42-003-007)

(NASA-CR-131229; SDSU-RSI-73-02) Avail: NTIS HC \$4.50 CSCL 08M

A study was conducted in Bennett County, South Dakota, to establish a rangeland test site for evaluating the usefulness of ERTS data for mapping soil resources in rangeland areas. Photographic imagery obtained in October, 1970, was analyzed to determine which type of imagery is best for mapping drainage and land use patterns. Imagery of scales ranging from 1:1,000,000 to 1:20,000 was used to delineate soil-vegetative physiographic units. The photo characteristics used to define physiographic units were texture, drainage pattern, tone pattern, land use pattern and tone. These units will be used as test data for evaluating ERTS data. The physiographic units were categorized into a land classification system. The various categories which were delineated at the different scales of imagery were designed to be useful for different levels of land use planning. The land systems are adequate only for planning of large areas for general uses. The lowest category separated was the facet. The facets have a definite soil composition and represent different soil landscapes. These units are thought to be useful for providing natural resource information needed for local planning.

Author

N73-20345*# Natural Resources Management Corp., Berkeley, Calif.

INVESTIGATION OF THE DETECTION AND MONITORING OF FOREST INSECT INFESTATION IN THE SIERRA NEVADA MOUNTAINS OF CALIFORNIA Progress Report, 1 Feb. - 31 Mar. 1973

01 AGRICULTURE AND FORESTRY

Ralph C. Hall, Principal Investigator 31 Mar. 1973 5 p
(Contract NAS5-21770)
(E73-10351; NASA-CR-131132) Avail: NTIS HC \$3.00 CSCL
02F

The author has identified the following significant results. Significant progress has been made in detecting insect outbreaks from ERTS-1 data during this period. It is possible to differentiate forested areas with heavy damage from those with little or no damage. The analysis is made with color infrared positive transparencies and prints. Enlargement of the transparencies makes it possible to detect and map areas of three degrees of tree mortality into heavy, medium, and light. It was also noted that shadows cast by massive rock domes closely resemble natural lakes.

N73-20348* Purdue Univ., Lafayette, Ind.
EVALUATION AND COMPARISON OF ERTS MEASUREMENTS OF MAJOR CROPS AND SOIL ASSOCIATIONS FOR SELECTED SITES IN THE CENTRAL UNITED STATES Bimonthly Progress Report, 1 Jan. - 28 Feb. 1973
Marion F. Baumgardner, Principal Investigator 28 Feb. 1973 3 p
(Contract NAS5-21785)
(E73-10384; NASA-CR-131133) Avail: NTIS HC \$3.00 CSCL
02C

N73-20352* Environmental Research Inst. of Michigan, Ann Arbor.
TASK 3: ATMOSPHERIC EFFECTS IN ERTS-1 DATA, 1410
Fred J. Thomson, Principal Investigator *In its Process*, and Analysis of ERTS-1 Remotely Sensed Data 15 Mar. 1973 1 p (For availability see N73-20349 11-13)
(E73-10390) CSCL 04A

The author has identified the following significant results. Results of crop mensuration and recognition studies in the Sacramento Valley indicate that the measurement of acreages of rice fields from ERTS-1 data can be dramatically improved by utilizing a processing technique which estimates the proportion of rice and bare soil in field boundary elements classified as corn by conventional pattern recognition techniques.

N73-20363* Alaska Univ., Fairbanks.
APPLICATION OF ERTS-1 IMAGERY TO THE STUDY OF CARIBOU MOVEMENTS AND WINTER DISPERSAL IN RELATION TO PREVAILING SNOWCOVER Bimonthly Progress Report
Peter C. Lent, Principal Investigator 31 Mar. 1973 3 p
(Contract NAS5-21833)
(E73-10401; NASA-CR-131137; BMRP-4) Avail: NTIS HC \$3.00 CSCL 08C

The author has identified the following significant results. Preliminary analysis of false color composite imagery has indicated the feasibility of using ERTS-1 imagery to map botanical community types important as caribou range in northeast Alaska.

N73-20369* Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.
INVENTORY OF FOREST AND RANGELAND AND DETECTION OF FOREST STRESS Progress Report, 1 Jan. - 28 Feb. 1973
Robert C. Heller, Principal Investigator, Robert C. Aldrich, Frederick P. Weber, and Richard S. Driscoll 8 Mar. 1973 37 p ref
(NASA Order S-70251-AG)
(E73-10407; NASA-CR-131143; FS-1-3; PR-3) Avail: NTIS HC \$4.00 CSCL 02F

The author has identified the following significant results. Three small scales of CIR photography were interpreted to determine the number of bark beetle-killed trees detected in each of six spot size categories. A procedure was developed to predict the probability of detecting spots in each spot size category and in turn to estimate the number of infestations and dead trees even on the smallest scale. Statistical tests of the data indicated that the linear model did not fit the data and that other models should be tested. As a result of daily monitoring of Black Hills radiometric instruments it was possible to show the spectral energy relationships in the ponderosa pine ecosystems over time. These data have been helpful for comparison with radiance signatures extracted from ERTS-1 bulk 70mm using precision microdensitometry. Effects of atmospheric interference were shown by a 30 percent increase in scene radiance on channel 4 of the satellite imagery. A calibration and scaling technique was developed and tested to enable interpretation of ERTS-1 bulk and precision data for the Atlanta test site. The technique includes calibration of a photographic copy system for the I2S image combiner and the production of scaled overlays of grid coordinate systems, study area locations, and outline maps of county boundaries.

N73-20370* Agricultural Research Service, Weslaco, Tex.
REFLECTANCE OF VEGETATION, SOIL, AND WATER Progress Report, 19 Dec. 1972 - 19 Feb. 1973
Craig L. Wiegand, Principal Investigator 19 Feb. 1973 9 p
(NASA Order S-70251-AG)
(E73-10408; NASA-CR-131144) Avail: NTIS HC \$3.00 CSCL
20N

The author has identified the following significant results. The ability to read the 24-channel MSS CCT tapes, select specified agricultural land use areas from the CCT, and perform multivariate statistical and pattern recognition analyses has been demonstrated. The 5 optimum channels chosen for classifying an agricultural scene were, in the order of their selection the far red visible, short reflective IR, visible blue, thermal infrared, and ultraviolet portions of the electromagnetic spectrum, respectively. Although chosen by a training set containing only vegetal categories, the optimum 4 channels discriminated pavement, water, bare soil, and building roofs, as well as the vegetal categories. Among the vegetal categories, sugar cane and cotton had distinctive signatures that distinguished them from grass and citrus. Acreages estimated spectrally by the computer for the test scene were acceptably close to acreages estimated from aerial photographs for cotton, sugar cane, and water. Many nonfarmable land resolution elements representing drainage ditch, field road, and highway right-of-way as well as farm headquarters area fell into the grass, bare soil plus weeds, and citrus categories and lessened the accuracy of the farmable acreage estimates in these categories. The expertise developed using the 24-channel data will be applied to the ERTS-1 data.

N73-20373* Bureau of Indian Affairs, Washington, D.C.
TIMBER RESOURCE INFORMATION SYSTEM Progress Report, 1 Jan. - 28 Feb. 1973
Arthur M. Woll, Principal Investigator 23 Mar. 1973 2 p
(NASA Order S-70243-AG-3)
(E73-10411; NASA-CR-131147) Avail: NTIS HC \$3.00 CSCL
02F

report.

N73-20375* Oregon State Univ., Corvallis. Rangeland Resources Program.
INVENTORY AND MONITORING OF NATURAL VEGETATION AND RELATED RESOURCES IN AN ARID ENVIRONMENT Progress Report, 1 Sep. 1972 - 28 Feb. 1973
Barry J. Schrumph, Principal Investigator, James R. Johnson, and David A. Mouat 20 Mar. 1973 48 p refs
(Contract NAS5-21831)
(E73-10413; NASA-CR-131149) Avail: NTIS HC \$4.50 CSCL
08F

The author has identified the following significant results. A vegetation classification has been established for the test site (approx. 8300 sq km): 31 types are recognized. Some relationships existing among vegetation types and associated terrain features have been characterized. Terrain features can be used to discriminate vegetation types. Macrorelief interpretations on ERTS-1 imagery can be performed with greater accuracy when using high sun angle stereoscopic viewing rather than low sun angle monoscopic viewing. Some plant phenological changes are being recorded by the MSS system.

N73-20380* Kansas Univ./Center for Research, Inc., Lawrence. Remote Sensing Lab.

CENTER PIVOT IRRIGATION IN FINNEY COUNTY, KANSAS: AN ERTS-1 INTERPRETATION PROCEDURE

Donald L. Williams and Bonnie Barker Nov. 1972 14 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(Contract NAS5-21822)

(E73-10418; NASA-CR-131208) Avail: NTIS HC \$3.00 CSCL 08H

N73-20389* Earth Satellite Corp., Berkeley, Calif. INVESTIGATION TO DEVELOP A MULTISTAGE FOREST SAMPLING INVENTORY SYSTEM USING ERTS-1 IMAGERY Progress Report, Nov. 1972 - Jan. 1973

Philip G. Langley, Principal Investigator Jan. 1973 4 p

(Contract NAS5-21853)

(E73-10428; NASA-CR-131218) Avail: NTIS HC \$3.00 CSCL 02F

The author has identified the following significant results. Two strips of U-2 RC-10 images were analytically triangulated and adjusted. Control points and pass points were marked on glass plates made from B&W copy negatives of IR color transparencies. A wild PUG-3 and TA1/p monocomparator were used to mark and measure the points on the glass plates. Each plate was measured twice in the same orientation for a check on accuracy and operator error. The 22 photographs were adjusted to 41 ground control and tie points and the block adjustment was performed in a secant plane coordinate system to eliminate the effect of earth curvature. Standard deviations of the residuals of the control and tie points were 12.8 m, 10.8 m, and 4.5 m for the X, Y, and Z coordinates respectively. The 12.8 m and 10.8 m figures correspond to an identification accuracy of 0.1 mm on the U-2 RC-10 plates. The standard deviations of the residuals encountered in the ERTS-1 resectioning were: (1) 0.16 mm assuming uncorrected perspective geometry and (2) 0.12 mm when the polynomial adjustment was added in. These results indicate a reduction of 0.11 in the square error due to the polynomial adjustment.

N73-20400* Natural Resources Management Corp., Berkeley, Calif.

INVESTIGATION OF THE DETECTION AND MONITORING OF FOREST INSECT INFESTATIONS IN THE SIERRA NEVADA MOUNTAINS OF CALIFORNIA Preliminary Data Analysis Report, 15 Dec. 1972 - 15 Feb. 1973

Ralph C. Hall, Principal Investigator 15 Feb. 1973 4 p

(Contract NAS5-21770)

(E73-10440; NASA-CR-131224) Avail: NTIS HC \$3.00 CSCL 02F

N73-20403* South Dakota State Univ., Brookings. Remote Sensing Inst.

EFFECTIVE USE OF ERTS MULTISENSOR DATA IN THE GREAT PLAINS Progress Report, period ending 31 Mar. 1973

Victor I. Myers, Principal Investigator 31 Mar. 1973 20 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(Contract NAS5-21774)

(E73-10443; NASA-CR-131238) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. In the case of rangelands, manipulation of the digitized material from photographic recordings revealed that the mode-seeking program using only one vegetation group gave the best output map. Efficient mapping of this imagery will possibly require the use of narrow band filters. In the case of cropland, the results obtained with the K-class classifier are shown. Using one feature, the highest percent correct classification was obtained using band 6. Using two features, best results were obtained using bands 4 and 6 and 5 and 6. Specific results obtained with various bands are discussed. In the case of land systems, the eroded shale soils located along the Missouri River reservoirs in South Dakota above the Fort Randall and Big Bend Dams are clearly visible on the IR bands of ERTS scene 17 August, 1972, image description number 1025-16551. The appearance of various types of soil formations is described.

N73-20410* Nevada Univ., Reno. Max C. Fleischman Coll of Agriculture.

USE OF SATELLITE IMAGERY FOR WILDLAND RESOURCE EVALUATION IN THE GREAT BASIN Progress Report

Paul T. Tueller, Principal Investigator Mar. 1973 18 p

(Contract NAS5-21870)

(E73-10460; NASA-CR-131250) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. Upon receipt of ERTS-1 imagery, scale and resolution determinations were made. It was found that the scale was quite close to the anticipated 1:1 million, and that each ERTS-1 frame had a coverage of approximately 12,500 square miles. A water body 275 feet across was identified on the MSS 7 band as a determination of maximum resolution. Large cities were easily distinguished on all bands. Paved highways and railroads were able to be identified when there was extreme contrast between those structures and surrounding areas. Landforms were identified on all bands, but band 5 proved superior. Vegetation of varying types was identified using band 7. Fields and agricultural areas were identified as was phreatophytic vegetation. Timber, pinyon-juniper, sagebrush, mountain brush, and annual grassland communities were identified on selected frames. Phenology comparisons of selected test sites were made using sequential U-2 imagery. It was found that gray scale and color IR changes relating to the phenology of certain annual grassland, mountain brush, and marsh communities could be identified. Water bodies were identified and delineated using band 7.

N73-20411* California Univ., Riverside. Citrus Research Center. EVALUATION OF REMOTE SENSING IN CONTROL OF PINK BOLLWORM IN COTTON. Progress Report, Feb. - Mar. 1973 Lowell N. Lewis, Principal Investigator and Virginia B. Coleman 10 Apr. 1973 8 p

(Contract NAS5-21771)

(E73-10452; NASA-CR-131251) Avail: NTIS HC \$3.00 CSCL 02C

N73-20421* Arizona Univ., Tucson. Dept. of Biological Sciences.

DETERMINATION OF SPECIES Progress Report

Charles H. Lowe, Principal Investigator and D. Slaymaker 12 Feb. 1973 2 p

(Contract NAS5-21819)

(E73-10466; NASA-CR-131273; PR-2) Avail: NTIS CSCL 08F

N73-21301* Centre for Overseas Pest Research, London (England).

TESTING FEASIBILITY OF DETECTING POTENTIAL LOCUST BREEDING SITES Progress Report

D. E. Pedgley, Principal Investigator 27 Apr. 1973 2 p

Sponsored by NASA ERTS

(E73-10462; NASA-CR-131528; PR-3) Avail: NTIS HC \$3.00 CSCL 06C

01 AGRICULTURE AND FORESTRY

N73-21305*# Tennessee Univ., Knoxville.

UTILIZATION OF ERTS DATA TO DETECT PLANT DISEASES AND NUTRIENT DEFICIENCIES, SOIL TYPES AND MOISTURE LEVELS Progress Report

W. L. Parks, Principal Investigator, J. I. Sewell, J. W. Hilty, and J. C. Rennie 9 Apr. 1973 17 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (Contract NAS5-21873)

(E73-10468; NASA-CR-131276; PR-1; PR-3) Avail: NTIS HC \$3.00 CSCL 20D

The author has identified the following significant results. A significant finding to date is the delineation of the Memphis soil association in Obion County, Dyer County, and in portions of Kentucky. This soil association was delineated mechanically through the use of imagery in the digital tape format, appropriate computer software, and an IBM/360/05 computer. The Waverly-Swamp association as well as the Obion River have been identified on the ERTS-1 imagery as well as on the computer printout. These findings demonstrate the feasibility of delineating major soil associations through vegetative cover common to the association. Channel 7 provides the most information for studies of this type. Computer density printouts assist markedly in making density separations and delineating major soil moisture differences; however, signatures for soil moisture classification for this area of mixed land uses in relatively small tracts have not yet been developed.

N73-21307*# Michigan State Univ., East Lansing. Agricultural Experiment Station.

USE OF ERTS DATA FOR A MULTIDISCIPLINARY ANALYSIS OF MICHIGAN RESOURCES Progress Report

Axel L. Anderson, Principal Investigator 10 Apr. 1973 17 p ERTS

(Contract NAS5-21834)

(E73-10470; NASA-CR-131278) Avail: NTIS HC \$3.00 CSCL 08F

N73-21309*# Kansas Univ./Center for Research, Inc., Lawrence. MONITORING CORN HARVEST PROGRESS FROM ERTS-1, SOUTHERN FINNEY COUNTY, KANSAS

Stanley A. Morain, Principal Investigator and Donald L. Williams 3 Jan. 1973 2 p ERTS

(Contract NAS5-21822)

(E73-10472; NASA-CR-131282) Avail: NTIS HC \$3.00 CSCL 02C

The author has identified the following significant results. Comparison of ERTS-1 imagery of three dates reveals that corn harvesting is detectable by observing tonal change associated with the change from photosynthetically active plants to bare ground.

N73-21312*# Kansas Univ./Center for Research, Inc., Lawrence. DISCRIMINATION OF WINTER WHEAT ON IRRIGATED LAND IN SOUTHERN FINNEY COUNTY, KANSAS

Stanley A. Morain, Principal Investigator, Donald L. Williams, Bonnie Barker, and Jerry C. Coiner 31 Jan. 1973 5 p ERTS (Contract NAS5-21822)

(E73-10475; NASA-CR-131285) Avail: NTIS HC \$3.00 CSCL 02C

The author has identified the following significant results. Winter wheat in the large field irrigated landscape of southern Finney County, Kansas was successfully discriminated by use of 4 ERTS-1 images. These images were acquired 16 August 1972, 21 September 1972, and 2 December 1972. MSS-5 images from each date and the MSS-7 image from 2 December 1972 were used. Human interpretation of the four images resulted in a classification scheme which produced 98% correct estimation of the number of wheat fields in the training sample and 100% correct estimation in the test sample. Overall correct separation of wheat from non-wheat fields was 93% and 86%, respectively. Offsetting errors resulted in the estimation accuracy for wheat.

N73-21313*# Mississippi State Univ., State College.

APPLICATION OF ERTS-A DATA TO AGRICULTURAL PRACTICES IN THE MISSISSIPPI DELTA REGION Interim Report, Nov. 1972 - Mar. 1973

C. W. Bouchillon, F. M. Ingels, Principal Investigators, and R. W. Boyd Apr. 1973 12 p ERTS

(Contract NAS5-21881)

(E73-10476; NASA-CR-131286) Avail: NTIS HC \$3.00 CSCL 02C

N73-21334*# Cornell Univ., Ithaca, N.Y. Div. of Atmospheric Sciences.

PHENOLOGY SATELLITE EXPERIMENT Progress Report, Aug. 1972 - Feb. 1973

Bernard E. Dethier, Principal Investigator 16 Apr. 1973 48 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21781)

(E73-10498; NASA-CR-131318) Avail: NTIS HC \$4.50 CSCL 02C

The author has identified the following significant results. The detection of a phenological event (the Brown Wave-vegetation senescence) for specific forest and crop types using ERTS-1 imagery is described. Data handling techniques including computer analysis and photointerpretation procedures are explained. Computer analysis of multispectral scanner digital tapes in all bands was used to give the relative changes of spectral reflectance with time of forests and specified crops. These data were obtained for a number of the twenty-four sites located within four north-south corridors across the United States. Analysis of ground observation photography and ERTS-1 imagery for sites in the Appalachian Corridor and Mississippi Valley Corridor indicates that the recession of vegetation development can be detected very well. Tentative conclusions are that specific phenological events such as crop maturity or leaf fall can be mapped for specific sites and possible for different regions. Preliminary analysis based on a number of samples in mixed deciduous hardwood stands indicates that as senescence proceeds both the rate of change and differences in color among species can be detected. The results to data show the feasibility of the development and refinement of phenoclimatic models.

N73-22267 Tennessee Univ., Knoxville.

REMOTE SENSING OF FALLOW SOIL MOISTURE USING VISIBLE AND INFRARED SENSORS Ph.D. Thesis

William Harold Allen 1972 109 p

Avail: Univ. Microfilms Order No. 72-27443

This study was designed to give a theoretical treatment of the cause-and-effect relationships between the physics of the soil and the resulting energy responses to be expected in the visible, near infrared, and thermal infrared wavelengths. Laboratory and field studies were performed to determine the feasibility of and the extent to which soil moisture levels of a fallow fine sandy loam Sequatchie soil could be detected and categorized using visible and near infrared photographic films and near and thermal infrared energy detectors as sensors. Color infrared film was exposed through four combinations of camera filters including Wratten No. 15 and 80B and Corning CS-1-59(3966). Other films used included infrared black-and-white and regular color film. Scanner detectors included the 2000- to 5000-nanometer range and the 8000- to 14000-nanometer range.

Dissert. Abstr.

N73-22283*# Earth Satellite Corp., Berkeley, Calif.

ERTS DATA USER INVESTIGATION TO DEVELOP A MULTISTAGE FOREST SAMPLING INVENTORY SYSTEM Progress Report, Sep. 1972 - Feb. 1973

Philip G. Langley, J. W. VanRoessel, Principal Investigators, and S. L. Wert 28 Feb. 1973 23 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (Contract NAS5-21853)

(E73-10508; NASA-CR-131546) Avail: NTIS HC \$3.25 CSCL 02F

The author has identified the following significant results. A system to provide precision annotation of predetermined forest inventory sampling units on the ERTS-1 MSS images was developed. In addition, an annotation system for high altitude U2 photographs was completed. MSS bulk image accuracy is good enough to allow the use of one square mile sampling units. IMANCO image analyzer interpretation work for small scale images demonstrated the need for much additional analysis. Continuing image interpretation work for the next reporting period is concentrated on manual image interpretation work as well as digital interpretation system development using the computer compatible tapes.

N73-22287* Idaho Univ., Moscow. Coll. of Forestry, Wildlife, and Range Sciences.

APPLICATION OF REMOTE SENSING IN THE STUDY OF VEGETATION AND SOILS IN IDAHO Interim Report, Nov. 1972 - May 1973

E. W. Tisdale, Principal Investigator May 1973 20 p ERTS (Contract NAS5-21850)

(E73-10512; NASA-CR-131470) Avail: NTIS HC \$3.00 CSCL 08M

The author has identified the following significant results. Comparison of ERTS-1 imagery and USGS 1:250,000 scale maps of study areas with known ground points revealed significant map errors. These errors were sufficient to render impractical the projection of ERTS-1 imagery directly onto maps of the area. Marked differences were found in the delineation of ground features by different MSS bands. Generally, Band 4 was least useful, while Band 5 proved valuable for indicating patterns of native vegetation, cultivated areas (both dry and irrigated), lava fields, drainage basins, and deep bodies of water. Band 6 was better for landforms and drainages and for shallow bodies of water than Band 5 but inferior for indicating patterns in native vegetation and most types of cultivated land. Band 7 was best of all for indicating lava flows, water bodies, and landform features. Use of an additive color viewer-projector aided greatly in separation of images. A combination of Bands 5 and 7 with appropriate color filters proved best for separating most types of native vegetation and cultivated crops. Landform features and water bodies also showed well with this combination. The addition of Band 4 imagery to these further enhanced the identification of semi-dormant vegetation.

N73-22288* Department of Agriculture, Washington, D.C. **CROP IDENTIFICATION AND ACREAGE MEASUREMENT UTILIZING ERTS IMAGERY** Progress Report, 20 Feb. - 19 Apr. 1973

Donald H. VonSteen, Principal Investigator 19 Apr. 1973 5 p ERTS

(NASA Order S-70251; AG-3)

(E73-10514; NASA-CR-131472) Avail: NTIS HC \$3.00 CSCL 02C

N73-22294* Earth Satellite Corp., Berkeley, Calif. **INVESTIGATION TO DEVELOP A MULTISTAGE FOREST SAMPLING INVENTORY SYSTEM USING ERTS-1 IMAGERY** Progress Report, Mar. - Apr. 1973

Philip G. Langley, Principal Investigator Apr. 1973 3 p refs ERTS

(Contract NAS5-21853)

(E73-10528; NASA-CR-131567) Avail: NTIS HC \$3.00 CSCL 02F

N73-22296* Earth Satellite Corp., Berkeley, Calif. **EVALUATION OF USEFULNESS OF SKYLAB EREP S-190 AND S-192 IMAGERY IN MULTISTAGE FOREST SURVEYS** Monthly Progress Report, 28 Feb. 1973 - 31 Mar. 1973

Philip G. Langley, Principal Investigator 31 Mar. 1973 3 p EREP

(Contract NAS9-13289)

(E73-10531; NASA-CR-131596) Avail: NTIS HC \$3.00 CSCL 02F

The author has identified the following significant results. To transfer points from topographic maps to space platform imagery a generalized resection program has been developed in which any resection parameter can be enforced in the solution to any desired extent. This allows for the use of orbital parameters in the resection solution. In addition to the resection program, a technique has been developed applicable to space platform photography with which elevations can be assigned to digitized map points through the use of digital terrain models. Using this technique tedious manual elevation assignment for thousands of digitized points can be avoided. The software to project the map points to the space platform image has also been developed and tested. Programs are being tested to relate the projected image coordinates to digital image tape locations so that any desired sample unit can be retrieved from the digital tapes with considerable accuracy.

N73-22298* Bureau of Sport Fisheries and Wildlife, Jamestown, N.D. Northern Prairie Wildlife Research Center.

APPRAISING CHANGES IN CONTINENTAL MIGRATORY BIRD HABITAT Progress Report, 1 Mar. - 30 Apr. 1973

Harvey K. Nelson, Principal Investigator 1 May 1973 3 p ERTS

(NASA Order S-70243-AG-4)

(E73-10534; NASA-CR-131610) Avail: NTIS HC \$3.00 CSCL 06C

N73-22306* Geological Survey, Tucson, Ariz. **DYNAMICS OF DISTRIBUTION AND DENSITY OF PHREATOPHYTES AND OTHER ARID LAND PLANT COMMUNITIES** Progress Report, 1 Jan. - 28 Feb. 1973

Raymond M. Turner, Principal Investigator 1 Apr. 1973 2 p ERTS

(NASA Order S-70243-AG-2)

(E73-10543; NASA-CR-131619) Avail: NTIS HC \$3.00 CSCL 08F

N73-22332* General Electric Co., Philadelphia, Pa. Missile and Space Div.

REMOTE SOIL MOISTURE MEASUREMENTS Final Report E. H. Stockhoff, R. T. Frost, and E. J. Buerger Mar. 1973 31 p refs

(Contract NAS5-21689)

(NASA-CR-130211) Avail: NTIS HC \$3.75 CSCL 08M

The degree of polarization of visible sunlight reflected from bare soils in agricultural test areas in the southwestern United States was measured by an airborne photopolarimeter. Surface soil specimens provided data concerning the surface moisture of the soil to which the polarization data were compared. The results indicate the feasibility of measuring soil surface moisture by airborne polarimeter instrumentation. Author

N73-22336* California Univ., Berkeley. Forestry Remote Sensing Lab.

ANALYSIS OF REMOTE SENSING DATA FOR EVALUATION OF VEGETATION RESOURCES Remote Sensing Applications in Forestry. Annual Progress Report

30 Sep. 1970 176 p refs Prepared in cooperation with Dept. of Agric. Forest Serv.

(NASA Order R-03-038-002)

(NASA-CR-131580) Avail: NTIS HC \$11.00 CSCL 02C

Research has centered around: (1) completion of a study on the use of remote sensing techniques as an aid to multiple use management; (2) determination of the information transfer at various image resolution levels for wildland areas; and (3) determination of the value of small scale multiband, multitime photography for the analysis of vegetation resources. In addition, a substantial effort was made to upgrade the automatic image classification and spectral signature acquisition capabilities of the laboratory. It was found that: (1) Remote sensing techniques should be useful in multiple use management to provide a first-cut

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analysis of an area. (2) Imagery with 400-500 feet ground resolvable distance (GRD), such as that expected from ERTS-1, should allow discriminations to be made between woody vegetation, grassland, and water bodies with approximately 80% accuracy. (3) Barley and wheat acreages in Maricopa County, Arizona, could be estimated with acceptable accuracies using small scale multiband, multidate photography. Sampling errors for acreages of wheat, barley, small grains (wheat and barley combined), and all cropland were 13%, 11%, 8% and 3% respectively. Author

N73-22337* California Univ., Berkeley. Pacific Southwest Forest and Range Experiment Station.

THE USE OF MULTISPECTRAL SENSING TECHNIQUES TO DETECT PONDEROSA PINES TREES UNDER STRESS FROM INSECTS OR DISEASES Remote Sensing Applications in Forestry. Annual Progress Report No. 5

R. C. Heller, F. P. Weber, and K. A. Zealear Berkeley, Calif. Calif. Univ. Forestry Remote Sensing Lab. 30 Sep. 1970 57 p refs Prepared for Calif. Univ., Berkeley. Forestry Remote Sensing Lab.

(NASA Order R-09-038-002)

(NASA-CR-131586) Avail: NTIS HC \$5.00 CSCL 02F

The detection of stress induced by bark beetles in conifers is reviewed in two sections: (1) the analysis of very small scale aerial photographs taken by NASA's RB-57F aircraft on August 10, 1969, and (2) the analysis of multispectral imagery obtained by the optical-mechanical line scanner. Underexposure of all films taken from the RB-57 aircraft and inadequate flight coverage prevented drawing definitive conclusions regarding optimum scales and film combinations to detect the discolored infestations. Preprocessing of the scanner signals by both analog and digital computers improved the accuracy of target recognition. Selection and ranking of the best channels for signature recognition was the greatest contribution of digital processing. Improvements were made in separating hardwoods from conifers and old-kill pine trees from recent discolored trees and from healthy trees, but accuracy of detecting the green infested trees is still not acceptable on either the SPARC or thermal-contouring processor. From six years of experience in processing line scan data it is clear that the greatest gain in previsual detection of stress will occur when registered multispectral data from a single aperture or common instantaneous field of view scanner system can be collected and processed. Author

N73-22339* California Univ., Berkeley. Pacific Southwest Forest and Range Experiment Station.

THE USE OF SPACE AND HIGH ALTITUDE AERIAL PHOTOGRAPHY TO CLASSIFY FOREST LAND AND TO DETECT FOREST DISTURBANCES Remote Sensing Applications in Forestry. Annual Progress Report

R. C. Aldrich, W. J. Greentree, R. C. Heller, and N. X. Norrick Berkeley, Calif. Calif. Univ. Forestry Remote Sensing Lab. 30 Sep. 1970 41 p refs Prepared for Calif. Univ., Berkeley. Forestry Remote Sensing Lab.

(NASA Order R-09-038-002)

(NASA-CR-131584) Avail: NTIS HC \$4.25 CSCL 02F

In October 1969, an investigation was begun near Atlanta, Georgia, to explore the possibilities of developing predictors for forest land and stand condition classifications using space photography. It has been found that forest area can be predicted with reasonable accuracy on space photographs using ocular techniques. Infrared color film is the best single multiband sensor for this purpose. Using the Apollo 9 infrared color photographs taken in March 1969 photointerpreters were able to predict forest area for small units consistently within 5 to 10 percent of ground truth. Approximately 5,000 density data points were recorded for 14 scan lines selected at random from five study blocks. The mean densities and standard deviations were computed for 13 separate land use classes. The results indicate that forest area cannot be separated from other land uses with a high degree of accuracy using optical film density alone. If, however, densities derived by introducing red, green, and blue cutoff filters in the optical system of the microdensitometer are combined with their differences and their ratios in regression analysis techniques, there is a good possibility of discriminating forest from all other classes. Author

N73-22340* California Univ., Berkeley.

POTENTIALLY EFFICIENT FOREST AND RANGE APPLICATIONS OF REMOTE SENSING USING EARTH ORBITAL SPACE CRAFT, CIRCA 1980 Remote Sensing Applications in Forestry. Special Report

Richard C. Wilson 31 Jan. 1970 205 p refs Sponsored by NASA Prepared in cooperation with Dept. of Agric. Forest Serv. (NASA-CR-131583) Avail: NTIS HC \$12.25 CSCL 02F

Sixteen remote sensing applications or groups of related applications judged to be most important of any in the forestry and range disciplines were evaluated. In one application, major land classification, large amounts of useful data are anticipated to be contributed by space sensors in 1980. In four applications moderate amounts are anticipated to be so contributed. These are timber inventory, range inventory, fire weather forecasting, and monitoring snowfields. In the following seven applications small but significant amounts of data are anticipated to be contributed by space sensors: (1) detailed land classification; (2) inventory of wildlife habitat; (3) recreation resource inventory; (4) detecting stresses on the vegetation (5) monitoring air pollution caused by wildfires and prescribed burning; (6) monitoring water cycle, (7) pollution and erosion; and (8) evaluating damage to forests and ranges. Author

N73-22341* California Univ., Berkeley. School of Forestry. **VIGOR LOSS IN CONIFERS DUE TO DWARF MISTLETOE** Remote Sensing Applications in Forestry. Annual Progress Report No. 1-

Merle P. Meyer, D. W. French, Robert P. Latham, and Charles A. Nelson Berkeley, Calif. Calif. Univ. Forestry Remote Sensing Lab. 30 Sep. 1970 25 p refs Prepared for Calif. Univ., Berkeley. Forestry Remote Sensing Lab. in cooperation with Dept. of Agric. Forest Serv.

(NASA Order R-09-038-002)

(NASA-CR-131582; APR-1) Avail: NTIS HC \$3.25 CSCL 02F

Practical remote sensing techniques were developed for detecting and evaluating vigor loss in forest conifers due to dwarf mistletoe. Eastern dwarf mistletoe (*Arceuthobium pusillum*) infection of black spruce (*Picea mariana*) was investigated. A tower-tramway system, 100 feet high, was erected over an infected stand in northeast Minnesota in June and multiband/multidate photography was initiated in July and is continuing. Four 70mm film-filter combinations were used in a multicamera unit: Plus-X/Wratten 58, Plus-X/Wratten 25A, Aero Infrared/Wratten 89B, and Ektachrome Infrared/Wratten 12. The stand of mistletoe-infected black spruce under the tramway was photographed three times per day (0900, 1200 and 1500 local sun time) at approximately 10 day intervals. An extensive test site, several square miles in area, was selected in north-central Minnesota for the purpose of testing photographic specifications developed on the tramway test site. One aerial photographic flight at a variety of altitudes was accomplished over the extensive test site in August. Data analyses are not available at this time. Author

N73-22342* California Univ., Berkeley. Dept. of Range Management.

INVENTORY OF NATIVE VEGETATION AND RELATED RESOURCES FROM SPACE PHOTOGRAPHY Remote Sensing Applications in Forestry. Annual Progress Report Charles E. Poulton, James R. Johnson, and David A. Moust Berkeley, Calif. Calif. Univ. Forestry Remote Sensing Lab. 30 Sep. 1970 39 p refs Sponsored by NASA Prepared for Calif. Univ., Berkeley. Forestry Remote Sensing Lab. in cooperation with Dept. of Agric. Forest Serv.

(NASA-CR-131581) Avail: NTIS HC \$4.00 CSCL 02F

The application of space and high flight photography to vegetational resources in Arizona is discussed. Ecologically based vegetation-landform and land use maps are prepared. The use of material from the Apollo 9 flight and high flight aerial photography are discussed. Land uses that result in a conversion or strong modification of the natural vegetation are presented.

The vegetation-landform units have an ecological basis and are meaningful from a land use point of view because they identify areas with unique potentials or limitations for use or development under various land uses. Examples of these relationships are given. Author

N73-22344*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
BASIC FOREST COVER MAPPING USING DIGITIZED REMOTE SENSOR DATA AND AUTOMATED DATA PROCESSING TECHNIQUES
 Michael E. Coggeshall and Roger M. Hoffer 1973 131 p refs
 (Grant NGL-15-005-112)
 (NASA-CR-131578; LARS-Info-Note-030573) Avail: NTIS HC \$8.75 CSCL 08B

Remote sensing equipment and automatic data processing techniques were employed as aids in the institution of improved forest resource management methods. On the basis of automatically calculated statistics derived from manually selected training samples, the feature selection processor of LARSYS selected, upon consideration of various groups of the four available spectral regions, a series of channel combinations whose automatic classification performances (for six cover types, including both deciduous and coniferous forest) were tested, analyzed, and further compared with automatic classification results obtained from digitized color infrared photography. Author

N73-22348*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
MULTISPECTRAL DETERMINATION OF VEGETATIVE COVER IN CORN CROP CANOPY
 E. R. Stoner and M. F. Baumgardner Jun. 1972 126 p refs
 (Grant NGL-15-005-112)
 (NASA-CR-131575; LARS-Print-111072) Avail: NTIS HC \$8.50 CSCL 02C

The relationship between different amounts of vegetative ground cover and the energy reflected by corn canopies was investigated. Low altitude photography and an airborne multispectral scanner were used to measure this reflected energy. Field plots were laid out, representing four growth stages of corn. Two plot locations were chosen—on a very dark and a very light surface soil. Color and color infrared photographs were taken from a vertical distance of 10 m. Estimates of ground cover were made from these photographs and were related to field measurements of leaf area index. Ground cover could be predicted from leaf area index measurements by a second order equation. Microdensitometry and digitization of the three separated dye layers of color infrared film showed that the near infrared dye layer is most valuable in ground cover determinations. Computer analysis of the digitized photography provided an accurate method of determining percent ground cover. Author

N73-23413*# Arizona Univ., Tucson.
A STUDY TO EXPLORE THE USE OF ORBITAL REMOTE SENSING TO DETERMINE NATIVE ARID PLANT DISTRIBUTION Progress Report, period ending 16 Apr. 1973
 William G. McGinnies, Principal Investigator 16 Apr. 1973 4 p ERTS
 (Contract NAS5-21812)
 (E73-10520; NASA-CR-131487) Avail: NTIS HC \$3.00 CSCL 08F

N73-23418*# Bureau of Land Management, Riverside, Calif.
PREDICT EPHEMERAL AND PERENNIAL RANGE QUANTITY AND QUALITY DURING NORMAL GRAZING SEASON Progress Report, 1 Mar. - 30 Apr. 1973
 Gordon Bently, Principal Investigator 1 May 1973 4 p ERTS
 (NASA Order S-70243-AG-1)
 (E73-10541; NASA-CR-131617) Avail: NTIS HC \$3.00 CSCL 08F

N73-23421*# Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.
INVENTORY OF FOREST AND RANGELAND AND DETECTION OF FOREST STRESS Progress Report, 1 Mar. - 30 Apr. 1973
 Robert C. Heller, Principal Investigator, Robert C. Aldrich, Frederick P. Weber, and Richard S. Driscoll 11 May 1973 12 p ERTS
 (NASA Order S-70251-AG)
 (E73-10546; NASA-CR-131650; PR-4) Avail: NTIS HC \$3.00 CSCL 02F

N73-23447*# Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.
INVENTORY OF FOREST AND RANGE RESOURCES, INCLUDING FOREST STRESS Monthly Progress Report, 15 Mar. - 15 May 1973
 Robert C. Heller, Robert C. Aldrich, Frederick P. Weber, and Richard S. Driscoll, Principal Investigators 15 May 1973 4 p
 Sponsored by NASA EREP
 (E73-10587; NASA-CR-131903; MPR-1) Avail: NTIS HC \$3.00 CSCL 02F

N73-24344*# Oregon State Univ., Corvallis. Rangeland Resources Program.
INVENTORY AND MONITORING OF NATURAL VEGETATION AND RELATED RESOURCES IN AN ARID ENVIRONMENT BY THE USE OF ERTS-A IMAGERY Progress Report, 1 Mar. - 30 Apr. 1973
 Barry J. Schrumpt, Principal Investigator 30 Apr. 1973 3 p ref ERTS
 (Contract NAS5-21831)
 (E73-10519; NASA-CR-131482; PR-3) Avail: NTIS HC \$3.00 CSCL 08F

N73-24367*# Nevada Univ., Reno.
USE OF SATELLITE IMAGERY FOR WILDLAND RESOURCE EVALUATION IN THE GREAT BASIN Progress Report
 Paul T. Tueller, Principal Investigator Mar. 1973 6 p ERTS
 (Contract NAS5-21870)
 (E73-10606; NASA-CR-132003) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. Color composites and diazochrome transparencies of ERTS-1 imagery have greatly increased interpretation capabilities. Vegetation green-up and flooding due to late summer precipitation has been identified on such imagery. MSS imagery in all bands has not proven as valuable for similar determinations. Snow cover has been found to be valuable in the identification of fire scars, pinyon/juniper chainings, and subtle ecotones not previously identified with any other type of imagery. It is felt that a greater understanding of the effects of snow cover on vegetation remote sensing will enable investigators to extend capabilities relating to the mapping and identification of these resources. Highly reflective phreatophytic vegetation has been mapped and quantified using the MSS 5 and 7 bands and diazochrome color composites. Approximately 10 man-hours were required to complete the entire state. Native meadow and hay meadow vegetation has been mapped in Elko County, Nevada, using ERTS-1 imagery. Future plans include a statewide inventory of this resource.

N73-24371*# Earth Satellite Corp., Berkeley, Calif.
EVALUATION OF USEFULNESS OF SKYLAB EREP S-190 AND S-192 IMAGERY IN MULTISTAGE FOREST SURVEYS Progress Report, 1 Apr. - 31 May 1973
 Philip G. Langley, Principal Investigator 31 May 1973 5 p EREF
 (Contract NAS9-13289)
 (E73-10610; NASA-CR-132007) Avail: NTIS HC \$3.00 CSCL 02F

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The author has identified the following significant results. A set of digital interpretation programs have been developed which perform the following tasks: (1) extraction of images for a desired sample unit or combination of sample units by scanner channel and storage of these images on high speed storage devices; (2) extraction of tone and texture information of 8 x 8 pixel interpretation units by channel and storage of these features on a high speed storage device; (3) center of gravity cluster node seeking in higher dimensional space and subsequent nearest neighbor classification, and output of the classification results on a high speed storage device. In all instances the classification results can be related to the original place of subset extraction through the coordinate transformation work previously performed.

N73-24376* Alaska Univ., Fairbanks.

APPLICATION OF ERTS-1 IMAGERY TO THE STUDY OF CARIBOU MOVEMENTS AND WINTER DISPERSAL IN RELATION TO PREVAILING SNOWCOVER Bimonthly Progress Report

Peter C. Lent, Principal Investigator 8 Jun. 1973 7 p ref ERTS

(Contract NAS5-21833)

(E73-10615; NASA-CR-132026; BMRP-5) Avail: NTIS HC \$3.00 CSCL 06C

The author has identified the following significant results. Step-wise discriminate analysis has demonstrated the feasibility of feature identification using linear discriminate functions of ERTS-1 MSS band densities and their ratios. The analysis indicated that features such as small streams can be detected even when they are in dark mountain shadow. The potential utility of this and similar analytic techniques appears considerable, and the limits it can be applied to analysis of ERTS-1 imagery are not yet fully known.

N73-24389* Nebraska Univ., Lincoln.

PROPOSAL TO EVALUATE THE USE OF ERTS-A IMAGERY IN MAPPING AND MANAGING SOIL AND RANGE RESOURCES IN THE SAND HILLS REGION OF NEBRASKA Progress Report, 1 Mar. - 30 Apr. 1973

James V. Drew, Principal Investigator 30 Apr. 1973 6 p ERTS (Contract NAS5-21756)

(E73-10629; NASA-CR-132040) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. There appears to be a direct relationship between densitometry values obtained with MSS band 5 imagery and forage density for those range sites measured on the imagery, provided site category identification is indicated by other forms of imagery or ground truth. Overlap of density values for different site categories with differing forage condition classes does not allow assigning a given forage density value for a given densitometer value unless the range site category is known.

N73-24398* Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.

AUTOMATIC PHOTOINTERPRETATION FOR PLANT SPECIES AND STRESS IDENTIFICATION (ERTS-A1) Progress Report

G. D. Swanlund, Principal Investigator and L. Kirvada 20 May 1973 6 p ERTS

(Contract NAS5-2186)

(E73-10639; NASA-CR-132098; PR-4) Avail: NTIS HC \$3.00 CSCL 08F

There are no author-identified significant results in this report.

N73-24399* Tennessee Univ., Knoxville.

UTILIZATION OF ERTS DATA TO DETECT PLANT DISEASES AND NUTRIENT DEFICIENCIES, SOIL TYPES AND MOISTURE LEVELS Progress Report

W. L. Parks, Principal Investigator, J. I. Sewell, J. W. Hilty, and J. C. Rennie 12 Jun. 1973 5 p refs ERTS

(Contract NAS5-21873)

(E73-10640; NASA-CR-132099; PR-2) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. Findings demonstrate the feasibility of delineating major terrain features, land uses, and crop species through computerized analyses. Channel 6 appears to give the most information for making separations of this type. By enlarging satellite imagery and visually comparing this with high altitude aerial photographs, locating small terrain features and cropland areas on satellite imagery is greatly facilitated. Forest types are discernable on the 2402 imagery with a #25 filter: pine stands have dark tones, hardwood stands have light tones, and pine-hardwood have intermediate tones. No textural differences are evident on this type of imagery. However, on the 2424 imagery with #89B filter, textural differences are evident but tonal differences are absent. Areas of considerable texture are interpreted as stands of high volume while areas of suppressed texture are of low volume. The 2402 imagery with a #57 filter appears to have little information of importance in timber inventory.

N73-25335* Mississippi State Univ., State College. Inst. for Environmental Studies.

APPLICATION OF ERTS-A DATA TO AGRICULTURAL PRACTICES IN THE MISSISSIPPI DELTA REGION Progress Report

C. W. Bouchillon, Principal Investigator 21 Jun. 1973 8 p ERTS

(Contract NAS5-21881)

(E73-10597; NASA-CR-132175; PR-3) Avail: NTIS HC \$3.00 CSCL 02D

N73-25340* Texas A&M Univ., College Station. Remote Sensing Center.

MONITORING THE VERNAL ADVANCEMENT AND RETROGRADATION (GREEN WAVE EFFECT) OF NATURAL VEGETATION Progress Report, 28 Mar. - 27 May 1973

J. W. Rouse, Jr., Principal Investigator 27 May 1973 15 p ERTS

(Contract NAS5-21857)

(E73-10643; NASA-CR-132979; PR-3) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. Continued evaluation of autumnal phase and early vernal phase data indicate that the quality of ERTS-1 imagery over the Great Plains Corridor test sites are adequate to show relatively small temporal changes in the condition and quantity of vegetation at the several test sites. Vegetation changes measured from August through April are observable in reflectance changes recorded by ERTS-1. Vegetation changes due to grazing treatment and environmental conditions at the test sites are being monitored with ground data and ERTS-1 data, and appear adequate to complete all phases of the Great Plains Corridor investigation. NASA high flight aerial photography proved to be an indispensable tool for locating the Great Plains Corridor test sites on the computer derived grey maps of ERTS-1 digital data.

N73-25355* Arizona Univ., Tucson.

A STUDY TO EXPLORE THE USE OF ORBITAL REMOTE SENSING TO DETERMINE NATIVE ARID PLANT DISTRIBUTION Progress Report, 16 Apr. - 16 Jun. 1973

William G. McGinnies, Principal Investigator 16 Jun. 1973 4 p ERTS

(Contract NAS5-21812)

(E73-10659; NASA-CR-132168) Avail: NTIS HC \$3.00 CSCL 08F

N73-25356* Cornell Univ., Ithaca, N.Y.

PHENOLOGY SATELLITE EXPERIMENT Progress Report, 8 Feb. - 8 Apr. 1973

Bernard E. Dethier, Principal Investigator 8 Apr. 1973 2 p refs ERTS

(Contract NAS5-21781)

(E73-10660; NASA-CR-132169) Avail: NTIS HC \$3.00 CSCL 08B

N73-25363*# Natural Resources Management Corp., Berkeley, Calif.

INVESTIGATION OF THE DETECTION AND MONITORING OF FOREST INSECT INFESTATION IN THE SIERRA NEVADA MOUNTAINS OF CALIFORNIA Progress Report, 1 Dec. 1972 - 31 May 1973

Ralph C. Hall, Principal Investigator 31 May 1973 10 p Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21770)

(E73-10668; NASA-CR-132179) Avail: NTIS HC \$3.00 CSCL 02F

The author has identified the following significant results. Results of analysis of ERTS-1 color composites made by NASA from MSS bands 4, 5, and 7, frame #1055-18055 at a scale of 1:1,000,000 indicate that forests damaged by insects can be delineated and mapped from areas with no damage; and at this same scale other details detected include timbered and nontimbered areas, pasture and agricultural land, deserts, lakes, mountain meadows, riparian vegetation, rock domes, old burned areas, and major stream courses. Enlargements from the above to a scale of 1:80,000 have improved detectability to the point that three degrees of timber mortality can be identified and mapped.

N73-25366*# Purdue Univ., Lafayette, Ind.

EVALUATION AND COMPARISON OF ERTS MEASUREMENTS OF MAJOR CROPS AND SOIL ASSOCIATIONS FOR SELECTED SITES IN THE CENTRAL UNITED STATES Bimonthly Progress Report, 1 Mar. - 30 Apr. 1973

Marion F. Baumgardner, Principal Investigator 30 Apr. 1973 8 p refs ERTS

(Contract NAS5-21785)

(E73-10670; NASA-CR-132181) Avail: NTIS HC \$3.00 CSCL 02D

The author has identified the following significant results. The most significant result was the use of the temporal overlay technique where the computer was used to overlay ERTS-1 data from three different dates (9 Oct., 14 Nov., 2 Dec.). The registration of MSS digital data from different dates was estimated to be accurate within one half resolution element. The temporal overlay capability provides a significant advance in machine-processing of MSS data. It is no longer essential to go through the tedious exercise of locating ground observation sites on the digital data from each ERTS-1 overpass. Once the address of a ground observation site has been located on a digital tape from any ERTS-1 overpass, the overlay technique can be used to locate the same address on a digital tape of MSS data from any other ERTS-1 pass over the same area. The temporal overlay technique also adds a valuable dimension for identifying and mapping changes in vegetation, water, and other dynamic surface features.

N73-25369*# National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, Tex.

DETECTION OF PRESCRIBED BURN ON NATIONAL FOREST

R. Bryan Erb, Principal Investigator [1973] 1 p ERTS

(E73-10674; NASA-TM-X-69263) Avail: NTIS HC \$3.00 CSCL 02F

The author has identified the following significant results. The effects of a prescribed burn in the Sam Houston National Forest have been detected from ERTS-1 coverage of November 27, 1972. The burn was first identified on aircraft under-flight photography of November 7, 1972. On color infrared aircraft photography it appeared as a green patch, indicating stressed vegetation, in an area of red coloration, indicating vigorous vegetation. It was later detected on the color composite of ERTS-1 bands 4, 5, and 7, as a black area in otherwise red vegetation. The fire, covering approximately 40 hectares (100 acres), was intentionally started to clear out heavy underbrush so that trees could be marked prior to harvesting. The significance of this observation is that a light burn of this type and its subsequent effects on vegetation could be detected on ERTS-1 imagery. Continued observation of this type of phenomenon under various conditions may provide a means of identifying such an occurrence without a prior knowledge of the event.

N73-25374*# South Dakota State Univ., Brookings.

ERTS DATA USER NO. 119: EFFECTIVE USE OF ERTS MULTISENSOR DATA IN THE GREAT PLAINS. ERTS-1 MSS IMAGERY: A TOOL FOR IDENTIFYING SOIL ASSOCIATIONS Progress Report, period ending 31 May 1973

Victor I. Myers, Principal Investigator and Frederick C. Westin 31 May 1973 38 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21774)

(E73-10679; NASA-CR-132186) Avail: NTIS HC \$4.00 CSCL 08M

The author has identified the following significant results. Soil association maps show the spatial relationships of land units developed in unique climatic, geologic, and topographic environments, and having characteristic slopes, soil depths, textures, available water capacities, permeabilities, and the like. ERTS-1 imagery was found to be a useful tool in the identification of soil associations since it provides a synoptic view of an 8 million acre scene, which is large enough so that the effect can be seen on soils of climate, topography, and geology. A regional view also allows soil associations to be observed over most, if not all, of their extent. ERTS-1 MSS imagery also provides four spectral bands taken every 18 days which give data on relief, hydrology, and vegetation, all of which bear on the delineation and interpretation of soil associations. Enlarged prints derived from the individual spectral bands and shown in gray tones were useful for identifying soil associations.

N73-25381*# Honeywell, Inc., St. Paul, Minn. Systems and Research Div.

COMPUTERIZED INTERPRETATION OF ERTS DATA FOR FOREST MANAGEMENT

Leonard Kirvida 16 Apr. 1973 7 p Proposed for presentation at Conf. on Machine Process. of Remotely Sensed Data, Lafayette, Ind., 16-18 Oct. 1973 ERTS

(Contract NAS5-21866)

(E73-10687; NASA-CR-132194) Avail: NTIS HC \$3.00 CSCL 02F

N73-25386*# Tennessee Univ., Knoxville. Dept. of Geography.

GEOGRAPHIC ANALYSIS OF LANDSCAPE CHANGE FROM ERTS-1 IMAGERY

John B. Rehder, Principal Investigator Jun. 1973 1 p ERTS

(Contract NAS5-21726)

(E73-10694; NASA-CR-132998) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. Data from low altitude flights and ground truth observations confirm the existence of significant strip mining activity at the Cumberland Plateau, Tennessee Test Site. A map (1:120,000) depicting landscape changes associated with strip mining on the Cumberland Plateau has been completed. The map was prepared from NASA generated RB-57 imagery for April 1972 and ERTS imagery for October 1972. A second map shows the generalized forest cover for the state of Tennessee. The data were derived entirely from five ERTS-1 images and reduced to an original map scale of 1:2.4 million. The most significant discovery concerns the detection, identification, and mapping of plowed fields in northern Alabama, northern Georgia, and southeastern Tennessee. In an April ERTS observation, plowed ground and bare soil surfaces were easily detected and mapped from MSS band 5.

N73-25388*# Bureau of Indian Affairs, Washington, D.C.

TIMBER RESOURCE INFORMATION SYSTEM Progress Report, 1 Mar. - 30 Apr. 1973

Arthur M. Woll, Principal Investigator 29 May 1973 3 p ERTS

(NASA Order S-70243-AG-3)

(E73-10696; NASA-CR-133000) Avail: NTIS HC \$3.00 CSCL 02F

01 AGRICULTURE AND FORESTRY

The author has identified the following significant results. The investigators are convinced that high altitude photography when supported with ground measurements and existing surveys, contain all the resource data needed for overall land management planning. This overall planning would include land use classification, environmental impact statements, and similar documentation. First inspection of the RBV ERTS imagery on the Quinault Reservation shows that much of the cultural and resources detail can be identified. Of particular note, is the obvious contrast between recently harvested timber cutting blocks as opposed to those cut more than a year ago. The RBV color composite would have been of better definition if band 3 had been excluded.

N73-26391* Iowa Engineering Experiment Station, Ames. **REMOTE SENSING IN IOWA AGRICULTURE** Progress Report, period ending 30 Jun. 1973
John P. Mahlstede, Principal Investigator, R. E. Carlson, and G. W. Thomson 28 Jun. 1973 5 p ERTS
(Contract NAS5-21839)
(E73-10699; NASA-CR-133012) Avail: NTIS HC \$3.00 CSCL 02C

N73-26399* Idaho Univ., Moscow. Coll. of Forestry, Wildlife and Range Sciences. **APPLICATION OF REMOTE SENSING IN THE STUDY OF VEGETATION AND SOILS IN IDAHO**
E. W. Tisdale, Principal Investigator 3 Jul. 1973 1 p ERTS
(Contract NAS5-21850)
(E73-10708; NASA-CR-133011) Avail: NTIS HC \$3.00 CSCL 08F

N73-26732* Kanner (Leo) Associates, Redwood City, Calif. **STUDY OF MICROWAVE RADIATION FROM THE SATELLITE COSMOS 243 OVER AGRICULTURAL LANDSCAPE**
G. M. Belyakova et al Washington NASA Jun. 1973 7 p ref. Transl. into ENGLISH from Dokl. Akad. Nauk (Moscow), v. 201, no. 4, 1971 p 837-839
(Contract NASw-2481)
(NASA-TT-F-14952) Avail: NTIS HC \$3.00 CSCL 20N

Results of microwave radiation studies over the European portion of the U.S.S.R. are studied. The objective is the determination of surface parameters in an area with planted crops. The measurement of radiation from the Cosmos 243 satellite and data on the temperature and humidity provided by the weather service were used. The European U.S.S.R. was selected because of the availability of good cartographic material and weather data in that area. Author

N73-26153* Scripta Technica, Inc., Washington, D.C. **MICROWAVE RADIATION CHARACTERISTICS OF DRY AND MOIST GROUND COVERS**
A. E. Basharinov NASA Jul. 1973 10 p refs Transl. into ENGLISH from "SVCH Radyatsionnye Kharakteristiki i Vlazhnykh Materikovykh Pokrovov" Moscow, 1973 11 p Presented at the meeting of the Soviet-American Working Group on Remote Sensing of Natural Environment from Space, 12-17 Feb. 1973 (Contract NASw-2484)
(NASA-TT-F-14975) Avail: NTIS HC \$3.00 CSCL 20N

Various uses and applications of spaceborne microwave measurements are given. Such measurements can be used to detect fires, measure soil moisture and temperature, measure sub-ice soil temperatures and the thickness of ice cover, as well as in the search for subsurface water. Author

N73-26315* Texas A&M Univ., College Station. Remote Sensing Center. **MONITORING THE VERNAL ADVANCEMENT AND RETROGRADATION (GREEN WAVE EFFECT) OF NATURAL VEGETATION** Progress Report, Sep. 1972 - Mar. 1973
John W. Rouse, Jr., Principal Investigator, R. H. Haas, J. A. Schell, and D. W. Deering Apr. 1973 120 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(Contract NAS5-21857)
(E73-10893; NASA-CR-132982) Avail: NTIS HC \$8.00 CSCL 08F

N73-26319* Bureau of Land Management, Riverside, Calif. **PREDICT EPHEMERAL AND PERENNIAL RANGE QUANTITY AND QUALITY DURING NORMAL GRAZING SEASON** Progress Report, 1 May - 30 Jun. 1973
Gordon Bentley, Principal Investigator 1 Jul. 1973 3 p ERTS
(NASA Order S-70243-AG-1)
(E73-10712; NASA-CR-133083) Avail: NTIS HC \$3.00 CSCL 08F

N73-26321* Bureau of Sport Fisheries and Wildlife, Jamestown, N.D. Northern Prairie Wildlife Research Center. **APPRAISING CHANGES IN CONTINENTAL MIGRATORY BIRD HABITAT** Progress Report, 1 Jan. - 30 Jun. 1973
Harvey K. Nelson, Principal Investigator and Edgar A. Work 1 Jul. 1973 12 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(NASA Order S-70243-AG-4)
(E73-10714; NASA-CR-133085) Avail: NTIS HC \$3.00 CSCL 06C

N73-26322* Iowa State Univ. of Science and Technology, Ames. **REMOTE SENSING IN IOWA AGRICULTURE** Progress Report, period ending 30 Apr. 1973
John P. Mahlstede, Principal Investigator and Richard E. Carlson 4 May 1973 4 p ERTS
(Contract NAS5-21839)
(E73-10715; NASA-CR-133215) Avail: NTIS HC \$3.00 CSCL 02C

The author has identified the following significant results. Photo-interpretive methods have been used for vegetation identification to include additive false color analysis using the I2S Miniadcol system. Enlarged black and white ERTS-1 imagery provides excellent synoptic coverage over large areas and this provides the vegetation type interpreter with a first tool. Analysis of field type using MSS bands individually gives the interpreter only shades of gray to base his decision. Combining the MSS bands and adding color through the I2S Miniadcol system provides the interpreter a greater degree of freedom in his decision making process. The information potentially available from ERTS-1 can be of great use in state planning and as an aid to the present crop survey programs.

N73-26326* Agricultural Research Service, Big Spring, Tex. **WIND EROSION OF SOILS** Progress Report, 29 Jul. 1972 - 17 Mar. 1973
Donald W. Fryrear, Principal Investigator 7 May 1973 3 p ERTS
(NASA Order S-70251-AG)
(E73-10719; NASA-CR-133219) Avail: NTIS HC \$3.00 CSCL 08M

N73-26334* Oregon State Univ., Corvallis. **INVENTORY AND MONITORING OF NATURAL VEGETATION AND RELATED RESOURCES IN AN ARID ENVIRONMENT BY THE USE OF ERTS-1 IMAGERY** Progress Report, 1 May - 30 Jun. 1973
Barry J. Schrumph, Principal Investigator 30 Jun. 1973 6 p ERTS
(Contract NAS5-21831)
(E73-10728; NASA-CR-133072; PR-4) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. An evaluation of information content of ERTS-1 reconstituted photography in comparison with Apollo 6 and Gemini 4 photography has been accomplished for some landforms through the use of an image groupability testing procedure. Analysis of terrain feature-vegetation relationships has been completed. Ground truth data collected in the southern Arizona test site have indicated that many of the plants can be categorized as either evergreen, cool season deciduous, or warm season deciduous. Results from image groupability testing have been utilized to stratify an Apollo 6 scene and an ERTS-1 scene of the same area.

N73-26340*# Department of Agriculture, Washington, D.C.
**CROP IDENTIFICATION AND ACREAGE MEASUREMENT
 UTILIZING ERTS IMAGERY** Progress Report, 20 Dec.
 1972 - 19 Jun. 1973

Donald H. VonSteen, Principal Investigator 19 Jun. 1973 11 p
 ERTS
 (NASA Order S-70251-AG-3)
 (E73-10734; NASA-CR-133078) Avail: NTIS HC \$3.00 CSCL
 02C

N73-26348*# Earth Satellite Corp., Berkeley, Calif.
**INVESTIGATION TO DEVELOP A MULTISTAGE FOREST
 SAMPLING INVENTORY SYSTEM USING ERTS-1 IMAGERY**
 Progress Report, May - Jun. 1973

Philip G. Langley, Principal Investigator and Jan W. VanRoessel
 May 1973 4 p ERTS
 (Contract NAS5-21853)
 (E73-10743; NASA-CR-133087) Avail: NTIS HC \$3.00 CSCL
 02F

N73-26361*# Agricultural Research Service, Weslaco, Tex.
SOIL SALINITY DETECTION

Craig L. Wiegand, Principal Investigator 2 Jul. 1973 2 p
 EREP
 (NASA Order T-4105-B)
 (E73-10761; NASA-CR-133129) Avail: NTIS HC \$3.00 CSCL
 08M

N73-26393*# Scientific Translation Service, Santa Barbara,
 Calif.
**REPORT OF STUDY ON VEGETATION, SOIL AND LAND
 USE AT KEY SITES**

B. V. Vinogradov Washington NASA Jun. 1973 6 p Transl.
 into ENGLISH of "Otchet po Programme SSSR po Izucheniyu
 Rastitelnosti, Pochvy i Ispolzovaniya zemel na Klyuchevykh
 Uchastkakh" Acad. of Sci., Inst. of Space Res., Moscow, report,
 1973 4 p Presented at Meeting of Soviet-Am. Working Group
 on Remote Sensing of Natural Environment from Space, Moscow,
 12-17 Feb. 1973
 (Contract NASw-2483)

(NASA-TT-F-14967) Avail: NTIS HC \$3.00 CSCL 08M

A description is given of remote sensing methods to study
 the vegetation, soil, and agricultural use of the land. Photographs
 obtained by Soyuz-9, Salyut, and Meteor spacecraft were analyzed
 for this purpose. Author

N73-26414*# Air Force Systems Command, Wright-Patterson
 AFB, Ohio. Foreign Technology Div.
INFRARED MAPPING OF LARGE FOREST FIRES

V. I. Binenko, L. N. Dyachenko, and K. Ya. Kondratyev 14 Mar.
 1973 16 p refs Transl. into ENGLISH from Radiats. Issled. v
 Atmos. (USSR), no. 275, 1972 p 237-244

(AD-758613; FTD-HT-23-1866-72) Avail: NTIS CSCL 02/6
 Aerial studies on finding and mapping large-scale forest fires
 by the IR photography method were conducted in the summer
 of 1970 in Siberia. In studying the possibilities of using IR
 technology to discover forest fires from an aircraft IR pho-
 tographs were made of forest fires which were entirely or partially
 hidden by a thick smoke screen. GRA

N73-26438*# Texas A&M Univ., College Station. Remote
 Sensing Center.

**REMOTE MONITORING OF SOIL MOISTURE USING
 AIRBORNE MICROWAVE RADIOMETERS**

C. L. Kroll Jun. 1973 137 p refs
 (Contract NAS9-11155; Grant NGL-44-001-001)
 (NASA-CR-133102; RSC-43) Avail: NTIS HC \$9.00 CSCL
 14B

The current status of microwave radiometry is provided. The
 fundamentals of the microwave radiometer are reviewed with
 particular reference to airborne operations, and the interpretative
 procedures normally used for the modeling of the apparent
 temperature are presented. Airborne microwave radiometer
 measurements were made over selected flight lines in Chickasha,
 Oklahoma and Weslaco, Texas. Extensive ground measurements
 of soil moisture were made in support of the aircraft mission
 over the two locations. In addition, laboratory determination of

the complex permittivities of soil samples taken from the flight
 lines were made with varying moisture contents. The data were
 analyzed to determine the degree of correlation between measured
 apparent temperatures and soil moisture content. Author

N73-26444*# National Aeronautics and Space Administration.
 Goddard Space Flight Center, Greenbelt, Md.
**REMOTE SENSING OF SOIL MOISTURE WITH MI-
 CROWAVE RADIOMETER**

T. Schmugge, P. Gloersen, and T. Wilheit Aug. 1973 38 p
 refs Submitted for publication

(NASA-TM-X-66265; X-652-72-305) Avail: NTIS CSCL 14B

The use of microwave radiometry for the remote sensing of
 soil moisture has been studied in a series of aircraft flights over
 agricultural test areas in the southwestern U.S. The radiometers
 covered the wavelength range 0.8 cm to 21 cm. Ground truth
 in the form of gravimetric soil moisture measurements were
 obtained at each test site. The results indicate that it is possible
 to monitor soil moisture variations with airborne radiometers.
 The emission in general, is not a linear function of soil moisture
 and is affected by soil type and surface conditions such as
 roughness and vegetative cover. Author

N73-26447*# Kanner (Leo) Associates, Redwood City, Calif.
**POSSIBILITIES OF STUDYING AND MAPPING SOIL COVER
 ON THE BASIS OF SPACE PHOTOGRAPHY**

V. I. Kravtsova Washington NASA Jun. 1973 21 p refs
 Transl. into ENGLISH from "Vozmozhnosti Izucheniya i Kartografir-
 ovaniya Pochvennogo Pokrova po Kosmicheskim Snimkam"
 Moscow Presented at the meeting of the Soviet-American
 Working Group on Remote Sensing of Natural Environment from
 Space, 12-17 Feb. 1973

(Contract NASw-2481)
 (NASA-TT-F-14971) Avail: NTIS HC \$3.25 CSCL 08B

The use of photographs taken from spacecraft and artificial
 satellites in the study of soil cover in various territories is discussed.
 Differences in soil conditions are reflected in the photographs in
 terms of brightness of tone, using such indications as the state
 of the crops, natural vegetation, natural topography, etc. In many
 cases the photographs detect differences in soil conditions and
 details that cannot be determined from topographic and large-scale
 soil maps, and only with difficulty from aerial photographs.
 Examples are changes in the mechanical composition of soils,
 wind, and water erosion. Hence space photographs can be used
 advantageously in soil cartography. It was concluded that space
 photographs are a valuable tool in the study of the structure of
 soil systems, the detection of complex soils, and combinations
 of various types of soils that are characteristic of different natural
 conditions. Author

N73-27237*# Pacific Southwest Forest and Range Experiment
 Station, Berkeley, Calif.

**INVENTORY OF FOREST AND RANGELAND RESOURCES,
 INCLUDING FOREST STRESS** Monthly Progress Report,
 15 May - 15 Jun. 1973

Robert C. Heller, Robert C. Aldrich, Frederick P. Weber, and
 Richard S. Driscoll, Principal Investigators 15 Jun. 1973 6 p
 Sponsored by NASA EREP

(E73-10749; NASA-CR-133117; MPR-2) Avail: NTIS HC
 \$3.00 CSCL 02F

N73-27238*# South Dakota State Univ., Brookings.

[SKYLAB ORBITS] Monthly Report, period ending 1 Jun.
 1973

Victor I. Myers, Principal Investigator 20 Jul. 1973 2 p
 EREP

(Contract NAS9-13337)
 (E73-10756; NASA-CR-133124) Avail: NTIS HC \$3.00 CSCL
 22C

01 AGRICULTURE AND FORESTRY

N73-27248*# Oregon State Univ., Corvallis. Dept. of Soil Science.

MULTI-DISCIPLINE RESOURCE INVENTORY OF SOILS, VEGETATION AND GEOLOGY Progress Report, period ending 30 Jun. 1973

Gerald H. Simonson, Principal Investigator, D. P. Paine, R. D. Lawrence, J. A. Norgren, W. Y. Pyott, J. H. Herzog, R. J. Murray, and R. Rogers 17 Jul. 1973 25 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux falls, S. D. 57198 ERTS

(Contract NAS5-21831)

(E73-10770; NASA-CR-133137) Avail: NTIS HC \$3.25 CSCL 08G

The author has identified the following significant results. Computer classification of natural vegetation, in the vicinity of Big Summit Prairie, Crook County, Oregon was carried out using MSS digital data. Impure training sets, representing eleven vegetation types plus water, were selected from within the area to be classified. Close correlations were visually observed between vegetation types mapped from the large scale photographs and the computer classification of the ERTS data (Frame 1021-18151, 13 August 1972).

N73-27268*# Earth Satellite Corp., Berkeley, Calif.

EVALUATION OF USEFULNESS OF SKYLAB EREP S-190 AND S-192 IMAGERY IN MULTISTAGE FOREST SURVEYS Monthly Progress Report, 1-30 Jun. 1973

Philip G. Langley, Principal Investigator 30 Jun. 1973 3 p EREP

(Contract NAS9-13289)

(E73-10782; NASA-CR-133149; MPR-4) Avail: NTIS HC \$3.00 CSCL 02F

N73-27266*# Geological Survey, Tucson, Ariz.

DYNAMICS OF DISTRIBUTION AND DENSITY OF PHREATOPHYTES AND OTHER ARID-LAND PLANT COMMUNITIES Progress Report, 1 Mar. - 30 Apr. 1973

Raymond M. Turner, Principal Investigator 1 Jun. 1973 3 p ERTS

(NASA Order S-70243-AG-2)

(E73-10790; NASA-CR-133157) Avail: NTIS HC \$3.00 CSCL 08F

N73-27267*# Bureau of Sport Fisheries and Wildlife, Washington, D.C.

AN EVALUATION OF SPACE ACQUIRED DATA AS A TOOL FOR WILDLIFE MANAGEMENT IN ALASKA Progress Report, 1 Jul. 1972 - 1 May 1973

Bill J. VanTries, Principal Investigator 1 May 1973 6 p ERTS

(NASA Order S-70243-AG)

(E73-10791; NASA-CR-133158) Avail: NTIS HC \$3.00 CSCL 06C

The author has identified the following significant results. Interpretation of ERTS-1 imagery by color-coded densitometric displays and digital processes data verified that with adequate quadrat in situ sampling ERTS-1 data could be extrapolated to describe accurately the vegetative characteristics of analogous sites, and that surface acres of water for waterfowl production were obtainable for ponds a minimum of 5 acres in size.

N73-27279*# Bureau of Indian Affairs, Washington, D.C.

TIMBER RESOURCES INFORMATION SYSTEM Progress Report, 1 Jan. - 30 Jun. 1973

Arthur M. Woll, Principal Investigator 23 Jul. 1973 5 p ERTS

(NASA Order S-70243-AG-3)

(E73-10804; NASA-CR-133288) Avail: NTIS HC \$3.00 CSCL 02F

The author has identified the following significant results. The investigators are convinced that high altitude photography when supported with ground measurements and existing surveys, contains all the resource data needed for overall land management planning. This overall planning would include land use classification, environmental impact statements, etc. First

inspection of the ERTS-1 RBV imagery on the Quinalt Reservation shows that much of the cultural and resource detail can be identified. Of particular note, is the obvious contrast between recently harvested timber cutting blocks as opposed to those cut more than a year ago. The RBV color composite would have been of better definition if band 3 had been excluded. Land managers are disappointed at first viewing ERTS-1 imagery in that it is not stereoscopic and find the scale and resolution at the 9 x 9 format difficult to interpret or translate to their ground truth. Arrangements are being made to have 1:250,000 enlargement prints made for their use.

N73-27280*# Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.

INVENTORY OF FOREST AND RANGELAND AND DETECTION OF FOREST STRESS Progress Report, 1 Jan. - 30 Jun. 1973

Robert C. Heller, Principal Investigator, Robert C. Aldrich, Frederick P. Weber, and Richard S. Driscoll 10 Jul. 1973 21 p ERTS (NASA Order S-70251-AG)

(E73-10805; NASA-CR-133289) Avail: NTIS HC \$3.25 CSCL 20F

The author has identified the following significant results. Visual interpretation of the range site on the bulk color composite of scene 1028-17135 permits: (1) identification of six different grassland communities; (2) separation of grasslands from scrub communities and forest land; (3) identification of ponderosa pine from aspen but not to separate spruce-fir, Douglas-fir, and lodgepole pine from each other; (4) identification of surface dredging and new urban development in flat grasslands but not to identify new urban development in forested areas; (5) determination that the three scrub communities of willow, mountain mahogany, and oakbrush can not be separated from each other. Kudzu vine is a serious threat to forest management in Southeastern United States and can be detected on ERTS-1 multispectral data from early October to mid-November. At other dates, earlier or later, it is confused with other crops. All three forest sites have suffered from excessive cloudiness and snow cover. One good image of the island of Hawaii was received and the dying of native ohia trees between Mauna Loa and Mauna Kea volcanoes shows up as a dark area on the combined 70 mm image.

N73-27282*# Nebraska Univ., Lincoln. Dept. of Agronomy. **EVALUATION OF ERTS-1 IMAGERY IN MAPPING AND MANAGING SOIL AND RANGE RESOURCES IN THE SAND HILLS REGION OF NEBRASKA Progress Report, 1 Jan. - 30 Jun. 1973**

Paul M. SeEVERS and James V. Drew, Principal Investigators Jul. 1973 14 p ERTS

(Contract NAS5-21756)

(E73-10807; NASA-CR-133291) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. Collection of ground truth data provided ground cover percent and the components of ground cover makeup. Percent bare soil appears to have greatest influence on imagery density of sites studied. Forage density estimates can be made on band 5 of MSS, provided site category identification is known. Additional data are provided concerning forage density and vegetation-soil relationship by color composites of MSS imagery. Reflectance differences shown on MSS bands 6 and 7 by Sand Hills lakes are related to water quality and possibly more specifically to total dissolved ions present in the water. Winter imagery with snow cover and low sun angle shows a marked enhancement of topography are associated with differences in forage density. High altitude color infrared photography appears to be a usable tool for recognition, measurement, and evaluation of go-back land.

N73-27288*# Nevada Univ., Reno.

USE OF SATELLITE IMAGERY FOR WILDLAND RESOURCE EVALUATION IN THE GREAT BASIN Progress Report

Paul T. Tueller, Principal Investigator Jul. 1973 17 p ERTS (Contract NAS5-21870)

(E73-10813; NASA-CR-133297) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. Most major vegetation types of Nevada have been mapped with success. The completed set of mosaic overlays will be more accurate and detailed than previous maps compiled by various State and Federal agencies due to the excellent vantage point that ERTS-1 data affords. This new vegetation type map will greatly aid resource agencies in their daily work. Such information as suitable grazing areas, wildlife habitat, forage production, and approximate wildland production potentials can be inferred from such a map. There has been some success in detecting vegetational changes with the use of ERTS-1 MSS imagery, but exposure differences have somewhat confounded the results. Future plans include work to solve this problem.

N73-27290* Kansas Univ., Lawrence. Space Technology Center.

[SOIL MOISTURE ANALYSIS] Monthly Progress Report
Joe R. Eagleman, Principal Investigator 20 Jul. 1973 1 p EREP

(Contract NAS9-13273)

(E73-10815; NASA-CR-133309) Avail: NTIS HC \$3.00 CSCL 08M

N73-27304* Agricultural Research Service, Big Spring, Tex. **WIND EROSION OF SOILS Progress Report, 17 Mar. - 17 Jul. 1973**

Donald W. Fryrear, Principal Investigator 31 Jul. 1973 3 p ERTS

(NASA Order S-70251-AG)

(E73-10834; NASA-CR-133339) Avail: NTIS HC \$3.00 CSCL 08M

N73-27357# Oklahoma State Univ., Stillwater.

REMOTE SENSING RESEARCH PROJECT: BIBLIOGRAPHY ON REMOTE SENSING APPLICATIONS IN AGRICULTURE AND SOIL SURVEY Interim Report

Mohamed Abdel-Hady, Ahmed Abdel-Samie, and Hassan Mostafa Sep. 1972 290 p refs Prepared in cooperation with Acad. of Sci. Res. and Technol., Cairo

(Grant NSF GF-31866)

(PB-219103/9; IR-1) Avail: NTIS CSCL 08G

A comprehensive bibliography of the remote sensing applications to agriculture civil engineering, and geology is reported. Each volume is divided into annotated and unannotated references. Volume 1, enclosed, covers items about recent advances in the agricultural applications of infrared and color photography, electronics, side looking airborne radar, short wavelength radiation and multispectral sensing. The references cover special agricultural and soils applications such as crop identification, crop survey, crop disease in agriculture and forestry, soil survey, and drainage studies. Author (GRA)

N73-27363# Kansas State Highway Commission, Topeka.

SOIL IDENTIFICATION BY REMOTE SENSING TECHNIQUES IN KANSAS, PART 1

Alvis H. Stallard and Lewis D. Myers Jul. 1972 109 p refs Prepared in cooperation with Federal Highway Adm., Wash., D. C.

(PB-22037/6) Avail: NTIS HC \$3.00 CSCL 08M

The remote sensing program conducted by the State Highway Commission of Kansas in cooperation with the Federal Highway Administration are reported and results of visual interpretation are presented. Methods of collection and types of data are described including frequency and type of ground observation data. Color aerial photography was the best single source of data for engineering soil mapping. (Author Modified Abstract)

(GRA)

N73-28209* Kansas Univ. Center for Research, Inc., Lawrence.

IDENTIFICATION OF WINTER WHEAT FROM ERTS-1 IMAGERY

Donald L. Williams, Stanley A. Morain, Bonnie Barker, and Jerry C. Coiner /n NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 11-18 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-A1) CSCL 02C

Continuing interpretation of the test area in Finney County, Kansas, has revealed that winter wheat can be successfully identified. This successful identification is based on human recognition of tonal signatures on MSS images. Several different but highly successful interpretation strategies have been employed. These strategies involve the use of both spectral and temporal inputs. Good results have been obtained from a single MSS-5 image acquired at a critical time in the crop cycle (planting). On a test sample of 54,612 acres, 89 percent of the acreage was correctly classified as wheat or non-wheat and the estimated wheat acreage (19,516 acres) was 99 percent of the actual acreage of wheat in the sample area. Author

N73-28210* California Univ., Riverside. Dept. of Geography. **SEMI-AUTOMATIC CROP INVENTORY FROM SEQUENTIAL ERTS-1 IMAGERY**

Claude W. Johnson and Virginia B. Coleman /n NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 19-25 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-A2) CSCL 02C

The detection of a newly introduced crop into the Imperial (California) Valley by sequential ERTS-1 imagery is proving that individual crop types can be identified by remote sensing techniques. Initial results have provided an extremely useful product for water agencies. A system for the identification of field conditions enables the production of a statistical summary within two to three days of receipt of the ERTS-1 imagery. The summary indicates the total acreage of producing crops and irrigated planted crops currently demanding water and further indicates freshly plowed fields that will be demanding water in the near future. Relating the field conditions to the crop calendar of the region by means of computer techniques will provide specific crop identification for the 8000 plus fields. Author

N73-28211* South Dakota State Univ., Brookings.

CROP IDENTIFICATION USING ERTS IMAGERY

Maurice L. Horton and James L. Heilman /n NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 27-33 refs Submitted for publication ERTS

(Contract NASS-21774)

(Paper-A3; SDSU-RSI-J-73-02) CSCL 02C

Digital analysis of August 15 ERTS-1 imagery for southeastern South Dakota was performed to determine the feasibility of conducting crop surveys from satellites. Selected areas of bands 4, 5, 6, and 7 positive transparencies were converted to digital form utilizing Signal Analysis and Dissemination Equipment (SADE). The optical transmission values were printed out in a spatial format. Visual analysis of the printouts indicated that cultivated areas were readily distinguished from non-cultivated areas in all four bands. Bare soil was easily recognized in all four bands. Corn and soybeans, the two major crops in the area, were treated as separate classes rather than as a single class called row crops. Bands 6 and 7 provided good results in distinguishing between corn and soybeans. Author

01 AGRICULTURE AND FORESTRY

N73-28212° Polytechnical Univ. of Madrid (Spain). IDENTIFICATION OF LARGE MASSES OF CITRUS FRUIT AND RICE FIELDS IN EASTERN SPAIN

Fernando Lopez deSagredo and Francisco G. Salinas / In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 35-36 ERTS

(Paper-A4) CSCL 02C

ERTS-1 imagery has been successfully used for the identification of large areas of citrus groves and rice fields in the Valencia region of Eastern Spain. Results are encouraging and will facilitate the elaboration of a land use map with a fair degree of definition once methods prove to be fully operational. Author

N73-28213° General Electric Co., Philadelphia, Pa. Reentry and Environmental Systems Div.

ENGINEERING ANALYSIS OF ERTS DATA FOR SOUTH- EAST ASIAN AGRICULTURE

Howard L. Heydt and Arthur J. McNair (Cornell Univ., Ithaca, N. Y.) / In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 37-52 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-A5), CSCL 02C

The present program focuses on rice because of its importance world-wide as a food. Specifically, the focus is on rice fields in the Philippines. Two primary program objectives are: (1) to establish the feasibility of extracting from ERTS imagery the areas where rice is grown, and (2) to determine those measurements on the imagery which enable the assessment of crop condition. Achieving these objectives with procedures which can be cost-effective can lead the way toward yield prediction, irrigation system management, and similar functions which are known to be important needs in Southeast Asia. Author

N73-28214° Earth Satellite Corp., Berkeley, Calif. AN INTERREGIONAL ANALYSIS OF NATURAL VEGETA- TION ANALOGUES USING ERTS-1 IMAGERY

Charles E. Poulton and Robin I. Welch / In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 53-57 ref ERTS

(Paper-A6) CSCL 02C

The identification of ecological analogs of natural vegetation and food crops using ERTS-1 imagery is discussed. Signatures of four natural vegetation analogs have been determined from color photography. Color additive techniques to improve the photointerpretation are examined. Tests were conducted at test sites in Louisiana, California, and Colorado. Author

N73-28215° Oregon State Univ., Corvallis. Rangeland Resources Program.

NATURAL VEGETATION INVENTORY

Barry J. Schrumph / In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 59-66 refs ERTS

(Contract NAS5-21831)

(Paper-A7) CSCL 08F

Unique characteristics of ERTS imagery can be used to inventory natural vegetation. While satellite images can seldom be interpreted and identified directly in terms of vegetation types, such types can be inferred by interpretation of physical terrain features and through an understanding of the ecology of the vegetation. Author

N73-28218° Nebraska Univ., Lincoln. Dept. of Agronomy. EVALUATION OF ERTS-1 IMAGERY IN MAPPING AND MANAGING SOIL AND RANGE RESOURCES IN THE SAND HILLS REGION OF NEBRASKA

Paul M. Seevers and James V. Drew / In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 87-89 ERTS

(Paper-A10) CSCL 08B

Interpretations of high altitude photography of test sites in the Sandhills of Nebraska permitted identification of subirrigated range sites as well as complexes of choppy sands and sands range sites, units composing approximately 85% of the Sandhills rangeland. These range sites form the basic units necessary for the interpretation of range condition classes used in grazing management. Analysis of ERTS-1 imagery acquired during August, September and October, 1972 indicated potential for the identification of gross differences in forage density within given range sites identified on early season aerial photography. Author

N73-28219° California Univ., Berkeley. Forestry Remote Sensing Lab.

MONITORING CALIFORNIA'S FORAGE RESOURCE USING ERTS-1 AND SUPPORTING AIRCRAFT DATA

David M. Carneggie and Stephen D. DeGloria / In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 91-95 ERTS

(Paper-A11) CSCL 08F

NASA's Earth Resource Technology Satellite (ERTS-1) launched July 23, 1972, offers for the first time the unique capabilities for regional monitoring of forage plant conditions. The repetitive coverage every 18 days, the synoptic view and the real-time recovery of the imagery for immediate analysis, combine to make the ERTS satellite a valuable tool for improving the evaluation of our rangeland resources. Studies presently underway at the University of California, Berkeley (sponsored jointly by NASA and the Bureau of Land Management), seek to determine if imagery obtained from high altitude aircraft and spacecraft (ERTS) can provide: (1) a means for monitoring the growth and development of annual and perennial range plants in California, and for determining the time and the rate of initial plant growth (germination) and terminal plant growth (maturation and senescence); (2) a means for determining or predicting the relative amount of forage that is produced; and (3) a means for mapping rangeland areas having different forage producing capabilities. Author

N73-28220° California Univ., Berkeley. TESTING THE USEFULNESS OF ERTS-1 IMAGERY FOR INVENTORYING WILDLAND RESOURCES IN NORTHERN CALIFORNIA

Donald T. Lauer and Paul F. Krumpke / In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 97-104 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-A12) CSCL 08F

The usefulness of ERTS-1 imagery for inventorying wildland resources in northern California is discussed. Studies are being conducted in two large wildland areas, namely, the Feather River Watershed and the Northern Coastal Zone. The 2.5 million-acre Feather River headwaters area in northern California is the keystone watershed for the California Water Project, one of the most extensive and ambitious water resource developments ever attempted. Consequently, accurate and timely information on the quantity, quality and distribution of timber, forage, water and recreational resources is of immediate importance to each public agency and private group managing this vast, but inaccessible, wildland area. The Northern Coastal Zone (consisting of the counties of Marin, Sonoma, Mendocino, Humboldt and Del Norte) is relatively rural, with an economy based on agriculture, timber, commercial fishing and tourism. However, it is expected that intensive resource use resulting from increasing population will soon become a serious problem unless wise land use planning is undertaken. Thus, this coastal region is particularly well suited to investigations of the ways in which ERTS-1 imagery and other supporting data may be used in conducting land use evaluations. Author

N73-28222* Tennessee Univ., Knoxville. Dept. of Soil Science and Electrical Engineering.

DELINEATION OF MAJOR SOIL ASSOCIATIONS USING ERTS-1 IMAGERY

W. L. Parks and R. E. Bodenheimer. In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 121-125 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-A14) CSCL 08M

The delineation of a major soil association in the loess region of Obion County has been accomplished using ERTS-1 imagery. Channel 7 provides the clearest differentiation. The separation of other smaller soil associations in an intensive row crop agricultural area is somewhat more difficult. Soil differentiation has been accomplished visually as well as electronically using a scanning microdensitometer. Lower altitude aircraft imagery permits a more refined soil association identification and where imagery is of sufficient scale, even individual soils may be identified. Author

N73-28223* California Univ., Riverside.
EVALUATION OF REMOTE SENSING IN CONTROL OF PINK BOLLWORM IN COTTON

Virginia B. Coleman, Claude W. Johnson, and Lowell N. Lewis. In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 127-133 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21771)

(Paper-A15) CSCL 02C

The use of satellite data from the ERTS-1 satellite for mapping the cotton acreage in the southern deserts of California is discussed. The differences between a growing, a defoliated, and a plowed down field can be identified using an optical color combiner. The specific application of the land use maps is to control the spread of the pink bollworms by establishing planting and plowdown dates. Author

N73-28224* Natural Resources Management Corp., Berkeley, Calif.

APPLICATION OF ERTS-1 IMAGERY AND UNDERFLIGHT PHOTOGRAPHY IN THE DETECTION AND MONITORING OF FOREST INSECT INFESTATIONS IN THE SIERRA NEVADA MOUNTAINS OF CALIFORNIA

Ralph C. Hall. In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 135-142 Original contains imagery. Original Photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-A16) CSCL 02F

The analysis of ERTS-1 imagery of areas in the Sierra Nevada Mountains of California is discussed. The data is used to detect two types of insect infestation and to determine the extent of timber resources. Addition applications are the mapping of stream courses, mountain meadows, lakes, rock outcrops, and grazing land. The ERTS-1 data and underflight photography are used for this purpose. Author

N73-28225* California Univ., Berkeley. Space Science Lab.
ERTS-1 IMAGERY AND HIGH FLIGHT PHOTOGRAPHS AS AIDS TO FIRE HAZARD APPRAISAL AT THE NASA SAN PABLO RESERVOIR TEST SITE

Robert N. Colwell. In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 145-156 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-A18) CSCL 08F

The identification of fire hazards at the San Pablo Reservoir Test Site in California using ERTS-1 data is discussed. It is stated that the two primary fire hazards in the area are caused by wild oat plants and eucalyptus trees. The types of imagery used in conducting the study are reported. Aerial photographs of specific areas are included to show the extent of the fire hazards. Author

N73-28226* Cornell Univ., Ithaca, N.Y.

PHENOLOGY SATELLITE EXPERIMENT

Bernard E. Dethier, Marshall D. Ashlev, (Maine Univ., Orono), Byron Blair (Purdue Univ.), and Richard J. Hopp (Vt. Univ., Burlington). In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 157-165 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-A19) CSCL 08F

The detection of a phenological event (the brown wave-vegetation senescence) for specific forest and crop types using ERTS-1 imagery is described. Data handling techniques included computer analysis and photo interpretation procedures. Computer analysis of ERTS-1 multispectral scanner digital tapes in all bands was used to give the relative changes of spectral reflectance with time of forests and specified crops. These data were obtained for a number of the study's twenty-four sites located within four north-south corridors across the United States. Analysis of ground observation photography and ERTS-1 imagery for sites in the Appalachian Corridor and Mississippi Valley Corridor indicates that the recession of vegetation development can be detected very well. Tentative conclusions are that specific phenological events such as crop maturity or leaf fall can be mapped for specific sites and possibly for entire regions. Author

N73-28227* Lockheed Electronics Co., Houston, Tex. Aerospace Systems Div.

FOREST AND RANGE MAPPING IN THE HOUSTON AREA WITH ERTS-1

G. R. Heath and H. D. Parker. In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 167-172 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-A20) CSCL 08B

ERTS-1 data acquired over the Houston area has been analyzed for applications to forest and range mapping. In the field of forestry the Sam Houston National Forest (Texas) was chosen as a test site, (Scene ID 1037-18244). Conventional imagery interpretation as well as computer processing methods were used to make classification maps of timber species, condition and land-use. The results were compared with timber stand maps which were obtained from aircraft imagery and checked in the field. The preliminary investigations show that conventional interpretation techniques indicated an accuracy in classification of 63 percent. The computer-aided interpretations made by a clustering technique gave 70 percent accuracy. Computer-aided and conventional multispectral analysis techniques were applied to range vegetation type mapping in the gulf coast marsh. Two species of salt marsh grasses were mapped. Author

N73-28228* Michigan State Univ., East Lansing. Michigan Agricultural Experiment Station.

APPLICATION OF ERTS-1 DATA TO ANALYSIS OF AGRICULTURAL CROPS AND FORESTS IN MICHIGAN

Gene R. Safir, Wayne L. Myers, William A. Melila (Environ. Res. Inst. of Mich.), and James P. Morgenstern (Environ. Res. Inst. of Mich.). In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 173-180 ERTS

01 AGRICULTURE AND FORESTRY

CSCL 08F

The results reported are based on analysis of ERTS Frame 1033-15580 collected over southwestern Lower Michigan on August 25, 1972. Major agricultural crops such as corn and soybeans were approaching maturity at this date and forest canopies were dense. Extensive ground truth information was gathered by detailed field study of test strips. This detailed information was supplemented over larger areas by interpretation of RB-57 and C-47 photography and MSS imagery. Recognition processing of ERTS-1 MSS data was carried out on a digital computer. Fields and forest stands were selected as training sets and test areas. Aerial imagery was essential for locating the positions of these selected areas on ERTS digital tapes. The recognition process was successful for each type of vegetation which had a dense green canopy such as forests, corn, and soybeans. Bare soil was also recognizable as a category. Author

N73-28228° Environmental Research Inst. of Michigan, Ann Arbor.

CROP SPECIES RECOGNITION AND MEASUREMENT IN THE SACRAMENTO VALLEY

Frederick J. Thomson / In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 181-188 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-A22) Avail: NTIS CSCL 02C

The goal of the second recognition map was to delineate various crop species in a portion of the Sacramento Valley, and at the same time to determine how accurately each could be classified and measured from ERTS-1 data. The new recognition map, a new and concise display of the old map, and classification and measurement accuracy data are presented and discussed. The measurement accuracy, in particular, is affected by the presence of an edge effect one resolution wide surrounding nearly all fields. Points on the edge are misclassified because they contain a mixture of crop and bare soil. Using a processing technique to estimate the proportions of unresolved objects in this edge region a much improved measurement capability will be demonstrated. Author

N73-28230° National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

THE RESULTS OF AN AGRICULTURAL ANALYSIS OF THE ERTS-1 MSS DATA AT THE JOHNSON SPACE CENTER
R. M. Bizzell, L. C. Wade, H. L. Prior, and B. Spiers / In its Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 189-186 ERTS

(Paper-A23) CSCL 02C

The initial analysis of the ERTS-1 multispectral scanner (MSS) data at the Johnson Space Center (JSC), Houston, Texas is discussed. The primary data set utilized was the scene over Monterey Bay, California, on July 25, 1972, NASA ERTS ID No. 1002-18134. It was submitted to both computerized and image interpretative processing. An area in the San Joaquin Valley was submitted to an intensive evaluation of the ability of the data to (1) discriminate between crop types and (2) to provide a reasonably accurate area measurement of agricultural features of interest. The results indicate that the ERTS-1 MSS data is capable of providing the identifications and area extent of agricultural lands and field crop types. Author

N73-28231° California Univ., Berkeley. Forestry Remote Sensing Lab.

AGRICULTURAL APPLICATIONS OF ERTS-1 DATA

William C. Draeger / In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 197-204 ERTS

(Paper-A24) Avail: NTIS CSCL 02C

In an attempt to evaluate the usefulness of ERTS imagery for the production of land use stratifications as a preliminary step in the crop inventory process, all land within S. Joaquin County was delineated into broad land use and crop category classes based on their appearance on the ERTS-1 Color composite image. The stratification of the agricultural land use categories proved to be a relatively simple task, taking each of three interpreters approximately 30 minutes to complete. The three interpretations were quite similar requiring only minor revisions to produce a consensus stratification. A total of 13 different agricultural strata were recognized, differing both in general field size and relative proportions of crop types and degree of irrigation. Upon comparing these interpretations, it was concluded that nearly all boundaries were truly representative of differing cropping practices. In a number of cases, the stratifications agreed almost exactly with soil type boundaries as drawn by earlier soils surveys. Author

N73-28232° Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

IDENTIFICATION OF AGRICULTURAL CROPS BY COMPUTER PROCESSING OF ERTS MSS DATA

Marvin E. Bauer and Jan E. Cipra / In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 205-212 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21773; Grant NGL-15-005-112)

(Paper-A25) CSCL 02C

Quantitative evaluation of computer-processed ERTS MSS data classifications has shown that major crop species (corn and soybeans) can be accurately identified. The classifications of satellite data over a 2000 square mile area not only covered more than 100 times the area previously covered using aircraft, but also yielded improved results through the use of temporal and spatial data in addition to the spectral information. Furthermore, training sets could be extended over far larger areas than was ever possible with aircraft scanner data. And, preliminary comparisons of acreage estimates from ERTS data and ground-based systems agreed well. The results demonstrate the potential utility of this technology for obtaining crop production information. Author

N73-28270° Forest Management Inst., Ottawa (Ontario).
DETECTION, MAPPING AND ESTIMATION OF RATE OF SPREAD OF GRASS FIRES FROM SOUTHERN AFRICAN ERTS-1 IMAGERY

J. M. Wightman / In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B Original contains imagery. Original photography may be purchased from EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-E6) CSCL 08B

Sequential band-6 imagery of the Zambesi Basin of southern Africa recorded substantial changes in burn patterns resulting from late dry season grass fires. One example from northern Botswana, indicates that a fire consumed approximately 70 square miles of grassland over a 24-hour period. Another example from western Zambia indicates increased fire activity over a 19-day period. Other examples clearly define the area of widespread grass fires in Angola, Botswana, Rhodesia and Zambia. From the fire patterns visible on the sequential portions of the imagery, and the time intervals involved, the rates of spread of the fires are estimated and compared with estimates derived from experimental burning plots in Zambia and Canada. It is concluded that sequential ERTS-1 imagery, of the quality studied, clearly provides the information needed to detect and map grass fires and to monitor their rates of spread in this region during the late dry season. Author

N73-26286* Bureau of Sport Fisheries and Wildlife, Washington, D.C.

AN EVALUATION OF SPACE ACQUIRED DATA AS A TOOL FOR MANAGEMENT TO WILDLIFE HABITAT IN ALASKA
Bill J. VanTries */in* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 795-799 ERTS

(Paper-W11) CSCL 06C

The Bureau of Sport Fisheries and Wildlife ERTS experiment in Alaska attempts to yield information useful for three primary functions in the State. They are: (1) to test the feasibility of using ERTS data, in conjunction with aircraft acquired multispectral photography, to develop effective stratified sampling techniques, (2) to provide near real time assessment and evaluation of the quantity, quality, and distribution of waterfowl breeding habitat through frequent ERTS measurements of hydrologic, phenological and vegetational parameters, and (3) to provide basic mapping of vegetation and terrain in certain remote areas of the State for which little or no biological data now exist. Author

N73-26306* Polytechnical Univ. of Madrid (Spain).
INVESTIGATIONS USING DATA FROM EARTH RESOURCES TECHNOLOGY SATELLITE IN THE FIELDS OF AGRICULTURE/GEOGRAPHY. TIMBER INVENTORY (LAND USE) IN THE PROVINCE OF HUELVA, SPAIN
Emilio DeBenito, Serafin Lopez-Cuervo, and Joaquin Rodriguez */in* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 949-953 ERTS

(Paper-L9) CSCL 08F

A test site was chosen for the purpose of elaborating the patterns for the future total use of the satellite photographs. The election of the test site was made with the following criteria in mind: (1) a flat terrain for eliminating the dangers of shadows produced by a difficult topography; and (2) searching of well defined natural limits for the test site. Due to the lack of satellite photographs from the study area, a number of photos from the northern area of Spain have been studied from the point of view of obtaining answers from the spectra of the vegetation masses. Author

N73-26307* South Dakota State Univ., Brookings. Remote Sensing Inst.

IDENTIFICATION OF SOIL ASSOCIATIONS IN WESTERN SOUTH DAKOTA ON ERTS-1 IMAGERY
Frederick C. Westin and V. I. Myers */in* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 965-972 refs Submitted for publication ERTS

(Contract NAS5-21774)

(Paper-L11; SDSU-RSI-J-73-01) CSCL 08M

Soil association maps show the spatial relationships of land units having characteristic soil depths and textures, available water capacities, permeabilities, pH characteristics, plasticity indices, liquid limits, and the like, from which broad interpretations can be made such as how the soil is suited as a source for top soil, and as a source for sand and gravel, and how corrosive the soil is for steel and concrete, and what crop and grass yields can be expected. Film color composites of bands 4, 5 and 7 viewed over a light table with magnification show the soil associations of western South Dakota that are now recognized, and, in addition, several new soil association areas have been brought to light. Author

N73-26317* Pennsylvania State Univ., University Park. Office for Remote Sensing of Earth Resources.
MAPPING OF AGRICULTURAL LAND USE FROM ERTS-1 DIGITAL DATA

A. D. Wilson, G. A. Max, and G. W. Peterson */in* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1055-1058 refs ERTS

(Paper-L22) CSCL 08B

A study area was selected in Lancaster and Lebanon Counties, two of the major agricultural counties in Pennsylvania. This area was delineated on positive transparencies on MSS data collected on October 11, 1972 (1080-15185). Channel seven was used to delineate general land forms, drainage patterns, water and urban areas. Channel five was used to delineate highway networks. These identifiable features were useful aids for locating areas on the computer output. Computer generated maps were used to delineate broad land use categories, such as forest land, agricultural land, urban areas and water. These digital maps have a scale of approximately 1:24,000 thereby allowing direct comparison with U.S.G.S. 7.5 minute quadrangle sheets. Aircraft data were used as a form of ground truth useful for the delineation of land use patterns. Author

N73-26320* Honeywell, Inc., St. Paul, Minn. Systems and Research Div.

AUTOMATIC INTERPRETATION OF ERTS DATA FOR FOREST MANAGEMENT

Leonard Kirvida and Greg R. Johnson */in* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1075-1082 Prepared in cooperation with Minn. Univ., St. Paul Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-L25) CSCL 02F

Automatic stratification of forested land from ERTS-1 data provides a valuable tool for resource management. The results are useful for wood product yield estimates, recreation and wild life management, forest inventory and forest condition monitoring. Automatic procedures based on both multi-spectral and spatial features are evaluated. With five classes, training and testing on the same samples, classification accuracy of 74% was achieved using the MSS multispectral features. When adding texture computed from 8 x 8 arrays, classification accuracy of 99% was obtained. Author

N73-26372* Ohio Univ., Athens. Dept. of Geology.

MAPPING OF SOIL BANKS USING ERTS-1 PICTURES
Moid U. Ahmad, David A. Kantner, and John W. Antalovich (Kucera and Assoc., Inc., Mentor, Ohio) */in* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1575-1582 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

CSCL 08B

Earth Resources Technology Satellite (ERTS-1) pictures of different wavelengths (MSS 4,5,6,7) were used in the study of two strip mine areas in southeastern Ohio. The first area was near Piedmont Lake and the second area was near New Lexington. Prints were examined under a binocular microscope and the gray tone was correlated with the actual ground conditions at several sites. For the New Lexington area, color infrared pictures taken at an elevation of 18,000 feet were also used for correlation with the ERTS-1 imagery. The results indicate that MSS 5 and 7 are most useful in defining the stripped land and show that the hydrological and soil characteristics are remarkably different than the surrounding lands. Author

N73-26396* Oregon State Univ., Corvallis.

AGRICULTURE, FORESTRY AND RANGELAND RESOURCES

Charles E. Poulton */in* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 2 May 1973 p 71-99 refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

CSCL 08F

01 AGRICULTURE AND FORESTRY

The application of ERTS-1 imagery for providing information on agriculture, forestry, and rangeland resources is described. The use of the ERTS-1 system for stratification and sampling estimates of relatively small areas is discussed. Examples of maps to improve resource definition for land use planning, resource allocation, and resource development are provided. Inventories of various crops, as determined by photointerpretation of ERTS imagery are submitted in tabular form. Author

N73-28406* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
AGRICULTURE, FORESTRY, RANGE RESOURCES
William Crea *In its* Symp. on Significant Results obtained from the ERTS-1, Vol. 3 May 1973 p 1-17 refs ERTS

CSCL 08F

Significant results obtained from ERTS-1 observations of agriculture, forestry, and range resources are summarized. Four major parts are covered: (1) crop classification and mensuration; (2) timber and range resources survey and classification; (3) soil survey and mapping; and (4) subdiscipline areas. A.L.

N73-28418* Alaska Univ., Fairbanks. Alaska Cooperative Wildlife Research Unit.
APPLICATION OF ERTS-1 IMAGERY TO THE STUDY OF CARIBOU MOVEMENTS AND WINTER DISPERSAL IN RELATION TO PREVAILING SNOWCOVER Progress Report, Jan. - Jul. 1973
Peter C. Lent and Arthur J. LaPerriere, Principal Investigators
31 Jul. 1973 14 p ERTS
(Contract NAS5-21833)
(E73-10840; NASA-CR-133402) Avail: NTIS HC \$3.00 CSCL 08C

N73-28427* Tennessee Univ., Knoxville.
UTILIZATION OF ERTS DATA TO DETECT PLANT DISEASES AND NUTRIENT DEFICIENCIES, SOIL TYPES AND MOISTURE LEVELS Progress Report
W. L. Parks, J. I. Sewell, J. W. Hilty, and J. C. Rennie, Principal Investigators 8 Aug. 1973 3 p ERTS
(Contract NAS5-21873)
(E73-10849; NASA-CR-133427; PR-5) Avail: NTIS HC \$3.00 CSCL 02A

The author has identified the following significant results. The separation of the Mississippi Delta from the Memphis Association (Loess) is clearly defined in ERTS-1 imagery covering west Tennessee and Mississippi.

N73-28428* Geological Survey, Washington, D.C.
ERTS-MSS DIGITAL DATA, FIELD SPECTRAL MEASUREMENTS, AND MULTIBAND PHOTOGRAPHY FOR WETLANDS VEGETATION ANALYSIS
Virginia Carter and Jane Schubert (Am. Univ., Washington, D. C.)
[1973] 1 p Sponsored by NASA ERTS
(E73-10850; NASA-CR-133428) Avail: NTIS HC \$3.00 CSCL 08F

N73-28435* California Univ., Riverside. Citrus Research Center/Agricultural Experiment Station.
EVALUATION OF REMOTE SENSING IN CONTROL OF PINK BOLLWORM IN COTTON
Lowell N. Lewis, Principal Investigator, Virginia B. Coleman, and Claude W. Johnson 8 Aug. 1973 8 p Presented at the ERTS-1 Symp., Mar. 1973 and at the ann. meetings of the Assoc. of Pacific Coast Geographers, Jun. 1973 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(Contract NAS5-21771)
(E73-10858; NASA-CR-133446) Avail: NTIS HC \$3.00 CSCL 02C

The author has identified the following significant results. This project is to identify and map cotton fields in the southern deserts of California. Cotton in the Imperial, Coachella, and Palo Verde Valleys is heavily infested by the pink bollworm which affects both the quantity and quality of cotton produced. In California the growing season of cotton is regulated by establishing planting and plowdown dates. These procedures ensure that the larvae, whose diapause or resting period occurs during the winter months, will have no plant material on which to feed, thus inhibiting spring moth emergence. The underflight data from the U-2 aircraft has shown that it is possible to detect the differences between a growing, a defoliated, and plowed down field providing the locations of the fields are known. The ERTS-1 MSS data are being analyzed using an I2S optical color combiner to determine which combinations of dates and colors will identify cotton fields and thus provide the data needed to produce maps of the fields for the forthcoming season.

N73-28452 Reading Univ. (England).
THE APPLICATION OF MULTISPECTRAL SCANNING SYSTEMS TO AGRICULTURE AND FORESTRY
E. H. Roberts *In* Plessey Radar Res. Centre Multispectral Scanning Systems and their Appl. to Earth Resource Surveys Apr. 1973 p 51-84 refs

The main research and development work in the field of multispectral scanning (MSS) of relevance to European agriculture is summarized. The reflectance characteristics of plants, soils, and vegetation are described, and the problems of crop identification and inventory are discussed. The assessment and monitoring of crop yield, vigor, damage, and disease are also discussed. The ground truth and data processing requirements are noted and MSS and other techniques are compared. ESRO

N73-28509* Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROSPECTS FOR THE USE OF THERMAL AERIAL PHOTOGRAPHY FOR THE DETECTION OF FOREST FIRES
B. V. Shilin, E. S. Artsybashev, E. Ya. Karizhenskii, and V. F. Melnikov 24 May 1973 20 p Transl. into ENGLISH from Lesn. Khoz. (Moscow), no. 7, 1969 p 52-59
(AD-762259; FTD-MT-24-1868-72) Avail: NTIS CSCL 13/12

The brief translation discusses infrared aerial photography and reviews its use in detection of forest fires. It was used in volcanology, in geological mapping, in searches for hot springs, in oceanography and hydrology. Author

N73-28931* Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE DETECTION OF CENTERS OF COMBUSTION OF SMALL DIMENSIONS BY THE METHOD FOR IR PHOTOGRAPHY
V. I. Binenko, L. N. Dyachenko, K. Ya. Kondratyev, and A. P. Chernenko 25 May 1973 18 p refs Transl. into ENGLISH from Radiatsionnyy Issled. v Atmosfere (USSR), no. 275, 1972 p 226-236
(AD-762265; FTD-MT-24-1867-72) Avail: NTIS CSCL 17/5

The need for seeking a new, reliable method which makes it possible to detect centers of combustion in forest fires in early stages of their development is well known. Such a method can become the method of infrared photography from aircraft. The purpose of the report is to evaluate the possibilities of using infrared scanning equipment for the detection of centers of combustion of small dimensions. GRA

N73-29212* Earth Satellite Corp., Berkeley, Calif.
EVALUATION OF USEFULNESS OF SKYLAB EREP S-190 AND S-192 IMAGERY IN MULTISTAGE FOREST SURVEYS Monthly Progress Report, 1-31 Jul. 1973
Philip G. Langley, Principal Investigator 9 Aug. 1973 4 p EREP
(Contract NAS9-13289)
(E73-10861; NASA-CR-133449) Avail: NTIS HC \$3.00 CSCL 02F

The author has identified the following significant results. A high-flight U-2 imagery (1:120,000) volume interpretation model was developed which could be used to explain 50% of the volume variation occurring on the ground. Two interpreters interpreted 40 GLO land sections with known timber volume in terms of eight variables that could be estimated from the imagery. A multiple regression study was performed to relate the interpreted variables to the ground volumes. It was found that the best model consisted of two basic variables and their squares, namely: (1) the percentage of large trees, and (2) the crown density of the conifers on the parcel. The multiple correlation coefficient was 0.694 for this model.

N73-29219* Natural Resources Management Corp., Berkeley, Calif. Research and Development Div.
INVESTIGATION OF THE DETECTION AND MONITORING OF FOREST INSECT INFESTATIONS IN THE SIERRA NEVADA MOUNTAINS OF CALIFORNIA Progress Report, 1 Jun. - 31 Jul. 1973

Ralph C. Hall, Principal Investigator 31 Jul. 1973 6 p ERTS (Contract NAS5-21770)
(E73-10868; NASA-CR-133381) Avail: NTIS HC \$3.00 CSCL 02F

The author has identified the following significant results. It is possible to detect all major areas of lodgepole pine defoliated by the needle miner within a given target area. Ground checking and helicopter observations have confirmed that accurate designations have been obtained for the following areas: (1) timbered v.s. non-timbered areas, (2) damaged v.s. undamaged timber areas, (3) lakes, (4) dome shadows which resemble lakes, (5) mountain meadows, (6) pasture land, (7) agricultural land, (8) desert, and (9) riparian vegetation.

N73-29221* Mississippi State Univ., State College. Inst. for Environmental Studies.

A STUDY OF THE APPLICATION OF SKYLAB EREP DATA TO AGRICULTURE IN THE MISSISSIPPI DELTA ALLUVIAL PLAINS REGION Quarterly Progress Report, 23 Apr. - 23 Jul. 1973

C. W. Bouchillon, Principal Investigator 10 Aug. 1973 4 p EREP
(Contract NAS9-13363)
(E73-10870; NASA-CR-133383; QPR-1) Avail: NTIS HC \$3.00 CSCL 02C

N73-29232* Mississippi State Univ., State College. Inst. for Environmental Studies.

APPLICATION OF ERTS-A DATA TO AGRICULTURAL PRACTICES IN THE MISSISSIPPI DELTA REGION Progress Report, period ending 31 Jul. 1973

C. W. Bouchillon, Principal Investigator 16 Aug. 1973 6 p ERTS
(Contract NAS5-21881)
(E73-10881; NASA-CR-133517; PR-4) Avail: NTIS HC \$3.00 CSCL 02C

N73-29234* Oregon State Univ., Corvallis. Environmental Remote Sensing Applications Lab.

ERTS-1 IMAGERY ENABLES MONITORING OF FIELD BURNING IN WESTERN OREGON Special Report

G. H. Simonson, Principal Investigator, C. E. Poulton, and D. Jacques 24 Jul. 1973 5 p Sponsored by NASA Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(E73-10883; NASA-CR-133519) Avail: NTIS HC \$3.00 CSCL 08B

N73-29239* Arizona Univ., Tucson. Dept. of Biological Sciences.

DETERMINATION OF SPECIES

Charles H. Lowe, Principal Investigator and D. Slaymaker 14 Aug. 1973 2 p ERTS
(Contract NAS5-21819)
(E73-10890; NASA-CR-133528; Rept-3) Avail: NTIS HC \$3.00 CSCL 08F

N73-29240* Texas A&M Univ., College Station. Remote Sensing Center.

MONITORING THE VERNAL ADVANCEMENT AND RETROGRADATION (GREEN WAVE EFFECT) OF NATURAL VEGETATION Progress Report, 28 May - 27 Jul. 1973

John W. Rouse, Jr., Principal Investigator 27 Jul. 1973 11 p ERTS

(Contract NAS5-21857)
(E73-10891; NASA-CR-133531; PR-4) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. A comprehensive review of ERTS-1 MSS color composite imagery, obtained during the autumnal and vernal phases over the Great Plains Corridor test sites, shows that temporal changes in rangeland vegetation can be manually interpreted. The degree to which manual interpretations can be made from the MSS color composites appears to be limited primarily by variations in image reproduction quality. The vernal advancement and other phenophase related phenomena are observable from cycle to cycle and within a single frame for rangeland vegetation. Vegetation changes due to environmental conditions among the test sites and among grazing treatments within test sites are readily observable. An investigation has been initiated which will evaluate band-to-band ratios as an index of rangeland vegetation condition. Data currently available from August 1972 through April 1973 for the five southern test sites are being used to characterize band-to-band ratios as a function of quantity and quality of rangeland vegetation at each of the test sites.

N73-29242* Catholic Univ. of America, Washington, D.C.
[ERTS-1 IMAGERY OF VILLAGE AND CULTIVATION SITES IN NIGER AND UPPER VOLTA]

Priscilla Reining, Principal Investigator [1973] 1 p Sponsored by NASA ERTS
(E73-10893; NASA-CR-133532) Avail: NTIS HC \$3.00 CSCL 08B

N73-29244* Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.

INVENTORY OF FOREST AND RANGELAND RESOURCES, INCLUDING FOREST STRESS Monthly Progress Report, 15 Jul. - 15 Aug. 1973

Robert C. Heller, Robert C. Aldrich, Frederick P. Weber, and Richard S. Driscoll, Principal Investigators 22 Aug. 1973 5 p EREP

(NASA Order T-4106-B)
(E73-10895; NASA-CR-133552; MPR-4) Avail: NTIS HC \$3.00 CSCL 02F

N73-29254* Alaska Univ., Palmer. Inst. of Agricultural Sciences.

IDENTIFICATION OF PHENOLOGICAL STAGES AND VEGETATIVE TYPES FOR LAND USE CLASSIFICATION Semiannual Technical Report, Feb. - Jul. 1973

C. Ivan Branton, Principal Investigator and Jay D. McKendrick 31 Jul. 1973 14 p ERTS
(Contract NAS5-21833)
(E73-10905; NASA-CR-133562; SATR-2) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. A large grassland was located on the Kenai Peninsula which may be a potential grazing land. Two 1:250 K vegetation maps were constructed from ERTS-1 scenes 1049-20505 and 1066-20453 using 70 mm MSS chips and black and white prints for an area of 3.5 million acres. Another area (464,000 acres) was mapped using digital data. The latter map is the most accurate and detailed vegetation map of that area produced to date. Areal extents of identified vegetation types were derived for the area mapped from digital data. Early spring (prior to leafing out of deciduous trees) is suspected as being the best time for mapping Alaskan vegetation from MSS data due to the best time for mapping Alaskan vegetation from MSS data due to the radiometrically distinctness of the vegetation communities at that time. Vegetative overlays produced at 1:250 K compare favorably with vegetative maps compiled by Lloyd A. Spetzman and assembled by the joint Federal-State Land Use Planning Commission for Alaska.

01 AGRICULTURE AND FORESTRY

N73-29257*# Cornell Univ., Ithaca, N.Y. **ENGINEERING ANALYSIS OF ERTS DATA FOR RICE IN THE PHILIPPINES**

Arthur J. McNair, Principal Investigator and Howard L. Heydt (Gen. Elec. Co., Philadelphia, Pa.) [1973] 19 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21844)

(E73-10908; NASA-CR-133565) Avail: NTIS HC \$3.00 CSCL 02C

The author has identified the following significant results. Rice is an important food worldwide. Worthwhile goals, particularly for developing nations, are the capability to recognize from satellite imagery: (1) areas where rice is grown, and (2) growth status (irrigation, vigor, yield). A two-step procedure to achieve this is being investigated. Ground truth, and ERTS-1 imagery (four passes) covering 80% of a rice growth cycle for some Philippine sites, have been analyzed. One-D and three-D signature extraction, and synthesis of an initial site recognition/status algorithm have been performed. Results are encouraging, but additional passes and sites must be analyzed. Good position information for extracted data is a must.

N73-29274*# Cornell Univ., Ithaca, N.Y. **PHENOLOGY SATELLITE EXPERIMENT Progress Report, 8 Apr. - 8 Jun. 1973**

Bernard E. Dethier, Principal Investigator 8 Jun. 1973 3 p refs ERTS

(Contract NAS5-21781)

(E73-10925; NASA-CR-133582) Avail: NTIS HC \$3.00 CSCL 08F

N73-29276*# Iowa State Univ. of Science and Technology, Ames, Agriculture Experiment Station. **REMOTE SENSING IN IOWA AGRICULTURE: IDENTIFICATION AND CLASSIFICATION OF IOWA CROP LANDS USING ERTS-1 AND COMPLEMENTARY UNDERFLIGHT IMAGERY Progress Report, Mar. - Aug. 1973**

J. P. Mahlstede, R. E. Carlson, and G. W. Thomson, Principal Investigators 31 Aug. 1973 30 p Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21839)

(E73-10927; NASA-CR-133584) Avail: NTIS HC \$3.50 CSCL 02C

The author has identified the following significant results. Results of the continuing analysis of ERTS-1 imagery covering Iowa during 1972 and periods during 1973 are covered. Emphasis is placed on the identification and classification of major crop types at two test sites in Iowa. Standard photointerpretive methods were used in this analysis including the direct enlargement of black and white single-band products and additive color multi-band procedures using a minidcol system. The use of sequential coverage during the crop growing season is emphasized as a means to improve the effectiveness of ERTS-1 photo-interpretations of crop land acreage estimates in Iowa. Illustrative black and white and color prints of both ERTS-1 and underflight imagery are included. In addition, forest land inventories at one test site are reported. A new method for the inventory of forest lands using ERTS-1 imagery is reported and compared with estimates obtained using earlier underflight imagery.

N73-29410# Development and Resources Transportation Co., Silver Spring, Md.

AUTOMATIC PROCESSING OF AIRBORNE REMOTE SENSING DATA FOR PATTERN DISCRIMINATION OF JUNGLE AND OTHER VEGETATION AREAS Final Report
Leonard A. LeSchack, W. R. J. Brinley, and Dale E. McIvor May 1973 45 p refs

(Contract DAHCO4-70-C-0052)

(AD-762583; D/RT-9; AROD-9064-2-EN) Avail: NTIS CSCL 08/2

Aerochrome Infrared aerial photography taken over Barro Colorado Island in the Panama Canal Zone is the main source for simulating airborne multi-spectral line-scan data of tropical forest areas. With these new data, the variations of forest canopy spatial statistics as a function of angle of view and angle of sun have been studied. Using 50x50 m (on the ground) microdensitometer scan ensembles generated from the aerial photography, and frequency distribution and power spectrum analyses of the resulting data, the behavior of a young-mature forest at five different angles of view, and a mature and secondary forest at different times of day were studied. Time and angular variations were applied to various tropical vegetation types seen at Tocache, Peru, and illustrated in a 2x12 matrix form, and a preliminary qualitative as well as quantitative analysis has been presented. The authors conclude that the discussed techniques do have considerable merit for automatic vegetation mapping by airborne means, but that extensive further work would be required to produce the data catalogue and algorithms necessary to develop an on-line, operating system. (Modified author abstract) GRA

N73-30278*# Idaho Univ., Moscow. Coll. of Forestry, Wildlife, and Range Sciences.

APPLICATION OF REMOTE SENSING IN THE STUDY OF VEGETATION AND SOILS IN IDAHO

E. W. Tisdale, Principal Investigator 31 Aug. 1973 1 p ERTS

(Contract NAS5-21850)

(E73-10936; NASA-CR-133607) Avail: NTIS HC \$3.00 CSCL 08F

N73-30286*# Kansas Univ. Center for Research, Inc., Lawrence, Space Technology Labs.

[SOIL MOISTURE AND VEGETATION SURVEYS OF TEXAS AND KANSAS] Monthly Progress Report

Joe R. Eagleman, Principal Investigator 31 Aug. 1973 1 p EREP

(Contract NAS9-13273)

(E73-10944; NASA-CR-133620) Avail: NTIS HC \$3.00 CSCL 02C

N73-30292*# Geological Survey, Denver, Colo.

APPLICATION OF ERTS-1 IMAGERY TO DETECTING AND MAPPING MODERN EROSION FEATURES AND TO MONITORING EROSIONAL CHANGES, IN SOUTHERN ARIZONA Progress Report, 1 Feb. - 31 Mar. 1973

Roger B. Morrison, Principal Investigator and Maurice E. Cooley (Geological Survey, Tucson, Ariz.) 1 Apr. 1973 36 p ERTS (NASA Order S-70243-AG-4)

(E73-10950; NASA-CR-133626) Avail: NTIS HC \$4.00 CSCL 08B

The author has identified the following significant results. The chief results during the reporting period were three 1:1,000,000 scale maps made from one ERTS-1 frame (1085-17330, 16 October 1972) showing: (1) the three most important types of materials in terms of the modern erosion problem: the readily erodible soils, gravel piedmonts and basin-fill areas, and consolidated rocks; (2) alluvial fans (dissected and relatively undissected); and (3) (as an additional bonus) linear structural features. Eight key areas (small parts of the whole study area) were selected for detailed study, and mapping was started in two of them, by interpretation of ultrahigh (U-2 and RB-57) airphotos, supplemented by field studies. In these areas detailed mapping was done not only on the modern erosion phenomena (arroyos, gullies, modern flood plains and terraces, and areas of sheet erosion and deposition), but also other features pertinent to the erosion problem, such as slope-local relief, landforms rock units, soil particle size and erodibility, and classes of vegetative cover.

N73-30326 Joint Publications Research Service, Arlington, Va.
APPLICATION OF PHOTOGRAPHS FROM SPACE FOR SMALL-SCALE MAPPING AND STUDY OF FARM LANDS
L. F. Yanvareva and Ye. I. Nikolayevskaya In its Meeting of the Sov.-Am. Working Group on Remote Sensing of the Nat.

Environment from Space (JPRS-59739) 8 Aug. 1973 p F07-119 Transl. into ENGLISH from the publ. "Vstrecha Sovetsko-Amerikanskoy Rabochey Gruppy po Issledovaniyu Okruzhayushchey Sredy iz Kosmosa" Moscow, Acad. of Sci. USSR, 1973 13 p

Direct and indirect interpretive signs are discussed in terms of their significance in distinguishing features on space photographs of farm lands. These features provide information on the agricultural characteristics of the landscape, the relief of the terrain, and the nature of the natural vegetation. Two tables are presented which list the interpretive attributes of farm lands and of fields of farm crops. D.L.G.

N73-30328 Joint Publications Research Service, Arlington, Va. **SOIL COVER AND ITS INTERPRETATION BASED ON AIRCRAFT AND SPACE SURVEY DATA**

V. L. Andronnikov In its Meeting of the Sov.-Am. Working Group on Remote Sensing of the Nat. Environment from Space (JPRS-59739) 8 Aug. 1973 p 142-151 Transl. into ENGLISH from the publ. "Vstrecha Sovetsko-Amerikanskoy Rabochey Gruppy po Issledovaniyu Okruzhayushchey Sredy iz Kosmosa" Moscow, Acad. of Sci. USSR, 1973 13 p

The possibilities were investigated of interpreting and compiling soil maps in the vicinity of the Tsimlyanskiy international test site using the photograph taken from space by the Soyuz-9 spacecraft and aerial survey data. The scale of the space photograph was 1:2,000,000, and the aerial photograph's scale was different. The pictures were black and white. During the experiment, the photographic images of different soil from the aerial and space photographs were compared and analyzed for the territory of different natural regions. Sections of different watershed, terraces and flood plains of a steppe river were analyzed. The field test data are presented with indications of the morphological, physical and physical-chemical data for the investigated soil. Author

N73-31283* Nuclear Research Center, Athens, (Greece). **LAND USE, FOREST DENSITY, SOIL MAPPING, EROSION, DRAINAGE, SALINITY LIMITATIONS** Bimonthly Progress Report, 1 Dec. 1972 - 31 Jan. 1973

N. J. Yassoglou, Principal Investigator 31 Jan. 1973 10 p Sponsored by NASA ERTS (E73-10969; NASA-CR-133748) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. The results of analyses show that it is possible to obtain information of practical significance as follows: (1) A quick and accurate estimate of the proper use of the valuable land can be made on the basis of temporal and spectral characteristics of the land features. (2) A rather accurate delineation of the major forest formations in the test areas was achieved on the basis of spatial and spectral characteristics of the studied areas. The forest stands were separated into two density classes: dense forest, and broken forest. On the basis of ERTS-1 data and the existing ground truth information a rather accurate mapping of the major vegetational forms of the mountain ranges can be made. (3) Major soil formations are mappable from ERTS-1 data: recent alluvial soils; soil on quaternary deposits; severely eroded soil and lithosol; and wet soils. (4) An estimation of cost benefits cannot be made accurately at this stage of the investigation. However, a rough estimate of the ratio of the cost for obtaining the same amount information from ERTS-1 data and from conventional operations would be approximately 1:6 to 1:10, in favor of the ERTS-1.

N73-31284* Bureau of Sport Fisheries and Wildlife, Jamestown, N.D. Northern Prairie Wildlife Research Center.

UTILIZATION OF SKYLAB (EREP) SYSTEM FOR APPRAISING CHANGES IN CONTINENTAL MIGRATORY BIRD HABITAT Progress Report, period ending Aug. 1973

Harvey K. Nelson, Principal Investigator 1 Sep. 1973 3 p EREP

(NASA Order T-4114-B)

(E73-10972; NASA-CR-133751) Avail: NTIS HC \$3.00 CSCL 08C

N73-31288* Purdue Research Foundation, Lafayette, Ind. 02c

EVALUATION AND COMPARISON OF ERTS MEASUREMENTS OF MAJOR CROPS AND SOIL ASSOCIATIONS FOR SELECTED SITES IN THE CENTRAL UNITED STATES Bimonthly Progress Report, 1 Jul. - 31 Aug. 1973

Marion F. Baumgardner, Principal Investigator 31 Aug. 1973 6 p ERTS

(Contract NAS5-21785)

(E73-10981; NASA-CR-133760) Avail: NTIS HC \$3.00

The author has identified the following significant results. An unsupervised classification was run for an area around Tahoka Lake, Texas. Classes from the unsupervised were correlated with the available ground observations. Unsupervised classes which corresponded to major rangeland composition groups were used as a basis for a classification of most of Lynn County. Three classes of pasture were identified: (1) clear pasture, mostly grasses; (2) mixture of grasses and mesquite; and (3) areas of thick mesquite. In addition, one class called other included lakes and agricultural areas. It was found that differences in rangeland composition could be mapped from spectral data using computer-aided processing techniques. The T Bar Ranch, which surrounds the Double Lakes west of Tahoka, Texas, was chosen as a test area for the classification of rangeland. It was found that the classification was reasonably consistent with the low altitude oblique air photos.

N73-31289* Department of Agriculture, Washington, D.C. Statistical Reporting Service.

CROP IDENTIFICATION AND ACREAGE MEASUREMENT UTILIZING ERTS IMAGERY Progress Report, 20 Jun. - 19 Aug. 1973

Donald H. VonSteen, Principal Investigator 19 Aug. 1973 16 p ref ERTS

(NASA Order S-70251-AG-3)

(E73-10982; NASA-CR-133761) Avail: NTIS HC \$3.00 CSCL 02C

N73-31321* Minnesota Univ., St. Paul. Inst. of Agriculture Remote Sensing Lab.

ERTS-1 DATA APPLICATIONS TO MINNESOTA FOREST LAND USE CLASSIFICATION Annual Progress Report

Joseph E. Sizer, Principal Investigation (Minn. State Planning Agency), Ralph G. Eller, Merle P. Meyer, and Joseph J. Ulliman 1 Jul. 1973 35 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (Contract NAS5-21801)

(E72-11017; NASA-CR-133813; IARSL-73-2) Avail: NTIS HC \$3.75 CSCL 02F

The author has identified the following significant results. Color-combined ERTS-1 MSS spectral slices were analyzed to determine the maximum (repeatable) level of meaningful forest resource classification data visually attainable by skilled forest photointerpreters for the following purposes: (1) periodic updating of the Minnesota Land Management Information System (MLMIS) statewide computerized land use data bank, and (2) to provide first-stage forest resources survey data for large area forest land management planning. Controlled tests were made of two forest classification schemes by experienced professional foresters with special photointerpretation training and experience. The test results indicate it is possible to discriminate the MLMIS forest class from the MLMIS nonforest classes, but that it is not possible, under average circumstances, to further stratify the forest classification into species components with any degree of reliability with ERTS-1 imagery. An ongoing test of the resulting classification scheme involves the interpretation, and mapping, of the south half of Itasca County, Minnesota, with ERTS-1 imagery. This map is undergoing field checking by on the ground field cooperators, whose evaluation will be completed in the fall of 1973.

N73-31334* Bureau of Sport Fisheries and Wildlife, Washington, D.C.

AN EVALUATION OF SPACE ACQUIRED DATA AS A TOOL FOR MANAGEMENT OF WILDLIFE HABITAT IN THE STATE OF ALASKA Progress Report, 1 May - 31 Aug. 1973

01 AGRICULTURE AND FORESTRY

Billy J. VanTries, Principal Investigator 1 Sep. 1973 3 p
ERTS
(NASA Order S-70243-AG-1)
(E73-11030; NASA-CR-133862) Avail: NTIS HC \$3.00 CSCL
06C

N73-31357* Minnesota Univ., St. Paul. Inst. of Agriculture
Remote Sensing Lab.
**REMOTE SENSING APPLICATIONS IN AGRICULTURE AND
FORESTRY. APPLICATIONS OF AERIAL PHOTOGRAPHY
AND ERTS DATA TO AGRICULTURAL FOREST AND
WATER RESOURCES MANAGEMENT Annual Progress
Report**

1 Jul. 1973 91 p refs
(Grant NGL-24-005-263)
(NASA-CR-135483; IARSL-73-1) Avail: NTIS HC \$6.75 CSCL
14E

Remote sensing techniques are being used in Minnesota to
study: (1) forest disease detection and control; (2) water quality
indicators; (3) forest vegetation classification and management;
(4) detection of saline soils in the Red River Valley; (5) corn
defoliation; and (6) alfalfa crop productivity. Results of progress,
and plans for future work in these areas, are discussed. A.L.

N73-31359* Environmental Research Inst. of Michigan, Ann
Arbor. Infrared and Optics Div.
**ESTIMATING CROP ACREAGE FROM SPACE-SIMULATED
MULTISPECTRAL SCANNER DATA**

R. F. Nalepka and P. D. Hyde Aug. 1973 53 p refs
(Contract NAS9-9784)
(NASA-CR-134029; ERIM-31650-148-T) Avail: NTIS HC
\$4.75 CSCL 02C

The need for multispectral data processing methods to permit
the estimation of proportions of objects and materials appearing
within the instantaneous field of view of a scanning system is
discussed. An algorithm developed for proportion estimation is
described as well as other supporting processing techniques.
Application of this algorithm to space-simulated multispectral
scanner data is discussed and some results presented and
compared. Results indicate that, for this data set, the true
proportions of the various crops contained within this data set
are with one exception more closely in agreement with the
proportions determined by the proportion estimation algorithm
than with the proportions determined by conventional classification
algorithm. Author

N73-31361* Colorado State Univ., Fort Collins. Coll. of Forestry
and Natural Resources.

**VEGETATION CANOPY REFLECTANCE MODELS Final
Report, 1 Jul. 1971 - 30 Jun. 1973**
Robert E. Oliver and James A. Smith Jun. 1973 93 p refs
(Grant DA-ARO(D)-31-124-71-G165)
(AD-763222; AROD-9928-2-EN) Avail: NTIS CSCL 08/6

Stochastic and deterministic approaches to simulating the
spectroreflectance of shortgrass prairie vegetation have been
investigated. The stochastic approach uses randomly selected
variables for incoming light flux, plant geometry, and intrinsic
optical properties whereas the deterministic model is patterned
after the familiar Kubelka-Munk theory for diffuse reflectance.
The model results are compared with field and laboratory
measurements of Blue grama (*Bouteloua gracilis*) and successfully
predicts the non-Lambertian character of the canopy. The site
of the field measurements was the Pawnee National Grasslands,
the intensive study site of the International Biological Program.
Direct solar and diffuse sky irradiance and the optical properties
of Blue grama were measured in the 0.4 micrometer to 1.05
micrometers region of the spectrum using a field adapted EG
and G spectroradiometer with a computer based digital acquisition
system. Canopy geometry was measured with a laboratory
photographic technique with subsequent digitization of the profile
images. (Modified author abstract) GRA

N73-32219* Pacific Southwest Forest and Range Experiment
Station, Berkeley, Calif.

**INVENTORY OF FOREST AND RANGELAND RESOURCES
INCLUDING FOREST STRESS Monthly Progress Report,
16 Aug. - 15 Sep. 1973**

Robert C. Heller, Robert C. Aldrich, Frederick P. Weber, and
Richard S. Driscoll, Principal Investigators 15 Sep. 1973 5 p
EREP
(NASA Order T-4106-B)
(E73-11040; NASA-CR-133921; MPR-5) Avail: NTIS HC
\$3.00 CSCL 02F

N73-32227* Pacific Southwest Forest and Range Experiment
Station, Berkeley, Calif.

**ERTS IMAGERY - PROBLEMS AND PROMISES FOR
FORESTERS**

Robert C. Heller, Principal Investigator 28 Sep. 1973 18 p
refs Presented at Intern. Seminar held at Freiburg, 17-21 Sep.
1973 Original contains color imagery. Original photography may
be purchased from the EROS Data Center, 10th and Dakota
Avenue, Sioux Falls, S. D. 57198 ERTS
(NASA Order S-70251-AG)
(E73-11051; NASA-CR-133872) Avail: NTIS HC \$3.00 CSCL
02F

N73-32228* Pacific Southwest Forest and Range Experiment
Station, Berkeley, Calif.

**INVENTORY OF FOREST AND RANGELAND AND DETEC-
TION OF FOREST STRESS Progress Report, 1 Jul. - 31 Aug.
1973**

Robert C. Heller, Robert C. Aldrich, Frederick P. Weber, and
Richard S. Driscoll, Principal Investigators 20 Sep. 1973 17 p
ERTS
(NASA Order S-70251-AG)
(E73-11052; NASA-CR-133933; PR-5) Avail: NTIS HC
\$3.00 CSCL 02F

The author has identified the following significant results.
At the Atlanta site (226B) it was found that bulk color composites
for October 15, 1972, and April 13, 1973, can be interpreted
together to disclose the location of the perennial Kudzu vine
(*Pycnanthemum lobata*). Land managers concerned with Kudzu eradica-
tion could use ERTS-1 to inventory locations over 200 meters
(660 feet) square. Microdensitometer data collected on ERTS-1
Bulk photographic products for the Manitou test site (226C)
have shown that the 15-step gray-scale tablets are not of
systematic equal values corresponding to 1/14 the maximum
radiant energy incident on the MSS sensor. The gray-scale values
present a third-order polynomial function rather than a direct
linear relationship. Although data collected on step tablets for
precision photographic products appear more discrete, the density
variation within blocks is almost as great as variations between
blocks. These system errors will cause problems when attempting
to analyze radiometric variances among vegetation and land use
classes.

N73-32239* Honeywell, Inc., Minneapolis, Minn. Systems
and Research Div.

**AUTOMATIC PHOTOINTERPRETATION FOR PLANT
SPECIES AND STRESS IDENTIFICATION (ERTS-A1)
Progress Report**

George D. Swanlund, Principal Investigator and L. Kirvada 20 Jul.
1973 2 p ERTS
(Contract NAS5-21866)
(E73-11063; NASA-CR-135519; PR-5) Avail: NTIS HC
\$3.00 CSCL 08E

N73-32242* Alaska Univ., Palmer.
**IDENTIFICATION OF PHENOLOGICAL STAGES AND
VEGETATIVE TYPES FOR LAND USE CLASSIFICATION
Bimonthly Progress Report**

Jay D. McKendrick, Principal Investigator 1 Oct. 1973 6 p
ERTS

01 AGRICULTURE AND FORESTRY

(Contract NAS5-21833)
(E73-11068; NASA-CR-135522; BMPR-7) Avail: NTIS HC
\$3.00 CSCL 08F

The author had identified the following significant results. Digital signatures derived from the CDU are comparable to those taken from the printouts. Therefore, using the CDU to derive signatures should be more efficient, since there is considerable time required in turn around with the computer and time required locating vegetation stands on the printout.

N73-32244*# Forest Research Inst., Helsinki (Finland).
DEMONSTRATION OF THE APPLICABILITY OF SATELLITE DATA TO FORESTRY Progress Report
Kullervo Kuusela, Principal Investigator 5 Oct. 1973 6 p
Sponsored by NASA ERTS
(E73-11068; NASA-CR-135524; PR-2) Avail: NTIS HC
\$3.00 CSCL 20F

N73-32248*# Agricultural Research Service, Weslaco, Tex.
A STUDY OF THE EARLY DETECTION OF INSECT INFESTATIONS AND DENSITY/DISTRIBUTION OF HOST PLANTS Progress Report, 1-31 Aug. 1973
William G. Hart, Sammy J. Ingle, and M. R. Davis, Principal Investigators 31 Aug. 1973 3 p EREP
(NASA Order T-4109-B)
(E73-11073; NASA-CR-135542; PR-7) Avail: NTIS HC
\$3.00 CSCL 06C

N73-32249*# Agricultural Research Service, Weslaco, Tex.
A STUDY OF THE EARLY DETECTION OF INSECT INFESTATIONS AND DENSITY/DISTRIBUTION OF HOST PLANTS Progress Report, 1-31 Jul. 1973
William G. Hart, Sammy J. Ingle, and M. R. Davis, Principal Investigators 31 Jul. 1973 2 p EREP
(NASA Order T-4109-B)
(E73-11074; NASA-CR-135543; PR-8) Avail: NTIS HC
\$3.00 CSCL 06C

N73-32250*# Agricultural Research Service, Weslaco, Tex.
A STUDY OF THE EARLY DETECTION OF INSECT INFESTATIONS AND DENSITY/DISTRIBUTION OF HOST PLANTS Progress Report, 1-30 Jun. 1973
William G. Hart, Sammy J. Ingle, and M. R. Davis, Principal Investigators 30 Jun. 1973 2 p EREP
(NASA Order T-4109-B)
(E73-11075; NASA-CR-135544; PR-5) Avail: NTIS HC
\$3.00 CSCL 06C

N73-32251*# Agricultural Research Service, Weslaco, Tex.
A STUDY OF THE EARLY DETECTION OF INSECT INFESTATIONS AND DENSITY/DISTRIBUTION OF HOST PLANTS Progress Report, 1-31 May 1973
William G. Hart, Sammy J. Ingle, and M. R. Davis, Principal Investigators 31 May 1973 2 p EREP
(NASA Order T-4109-B)
(E73-11076; NASA-CR-135545; PR-4) Avail: NTIS HC
\$3.00 CSCL 06C

N73-32252*# Agricultural Research Service, Weslaco, Tex.
A STUDY OF THE EARLY DETECTION OF INSECT INFESTATIONS AND DENSITY/DISTRIBUTION OF HOST PLANTS Progress Report, 1-30 Apr. 1973
William G. Hart, Sammy J. Ingle, and M. R. Davis, Principal Investigators 30 Apr. 1973 2 p EREP
(NASA Order T-4109-B)
(E73-11077; NASA-CR-135546; PR-3) Avail: NTIS HC
\$3.00 CSCL 06C

N73-32254*# Bureau of Sport Fisheries and Wildlife, Jamestown, N.D.
UTILIZATION OF SKYLAB (EREP) SYSTEM FOR APPRAISING CHANGES IN CONTINENTAL MIGRATORY BIRD HABITAT Monthly Progress Report, Sep. 1973
Harvey K. Nelson and Edgar A. Work, Jr., Principal Investigators (Environ. Res. Inst. of Mich.) 5 Oct. 1973 4 p EREP
(NASA Order T-4114-B)
(E73-11079; NASA-CR-135548) Avail: NTIS HC \$3.00 CSCL 06C

N73-32258*# Tennessee Univ., Knoxville. Dept. of Plant and Soil Science.
UTILIZING ERTS IMAGERY TO DETECT PLANT DISEASES AND NUTRIENT DEFICIENCIES, SOIL TYPES AND SOIL MOISTURE LEVELS Interim Report, Mar. - Sep. 1973
W. L. Parks, Principal Investigator, J. I. Sewell, J. W. Hilty, and J. C. Rennie 29 Sep. 1973 16 p Original contains imagery. Original Photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(Contract NAS5-21873)
(E73-11091; NASA-CR-135559) Avail: NTIS HC \$3.00 CSCL 02C

The author has identified the following significant results. The delineation of soil associations and detection of drainage patterns, erosion and sedimentation through the use of ERTS-1 imagery are shown. Corn blight and corn virus could not be detected from ERTS-1 and detection of forest composition was at a very low probability.

N73-32259*# Earth Satellite Corp., Berkeley, Calif.
ERTS DATA USER INVESTIGATION TO DEVELOP A MULTISTAGE FOREST SAMPLING INVENTORY SYSTEM Progress Report, Feb. - Sep. 1973
Philip G. Langley and J. W. VanRoessel, Principal Investigators 25 Sep. 1973 37 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(Contract NAS5-21853)
(E73-11092; NASA-CR-135560) Avail: NTIS HC \$4.00 CSCL 02F

The author has identified the following significant results. A unique digital timber volume estimation system was developed for use with the MSS CCT tapes. The system was tested on a 64-square mile area in Northern California's Trinity Alps. The outcome of a systematic experiment, in which several possible combinations of bands 5 and 7 and a contrast measure were tried, showed that an estimated gain in precision of 50% can be obtained in a multistage sampling design. The difference between bands 5 and 7 proved to be of special importance for the estimation of biomass in the form of timber volume. In addition, an interpretation model for high flight U2 photographs was developed. A maximum multiple correlation coefficient of 0.74 was obtained for the regression model, explaining 55% of the variation in timber volume as estimated from aerial photos and ground measurements. An interpretation model for MSS color composites is in the testing stage.

N73-32260*# Earth Satellite Corp., Berkeley, Calif.
EVALUATION OF USEFULNESS OF SKYLAB EREP 8-190 AND 8-192 IMAGERY IN MULTISTAGE FOREST SURVEYS Progress Report, 1 Aug. - 30 Sep. 1973
Philip G. Langley, Principal Investigator 30 Sep. 1973 5 p EREP
(Contract NAS9-13289)
(E73-11093; NASA-CR-135561; PR-5) Avail: NTIS HC
\$3.00 CSCL 02F

The author has identified the following significant results. A unique digital timber volume estimation system with digital data for two ERTS-1 MSS bands was tested. The system was tested on a 64-square mile area in Northern California's Trinity Alps. The outcome of a systematic experiment in which possible combinations of the two bands (MSS 5 and 7) were tried, showed that an estimated gain in precision of 50% can be obtained in a multistage sampling design. Especially the difference between

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the two bands proved to be of major importance for the estimation of biomass in the form of timber volume. Identical tests as the one performed will be conducted with various S-192 bands when the digital data become available.

N73-32266* Minnesota Univ., Minneapolis. Space Science Center.

A STUDY OF MINNESOTA FORESTS AND LAKES USING DATA FROM EARTH RESOURCES TECHNOLOGY SATELLITES Annual Progress Report, 1 Jul. 1972 - 30 Jun. 1973 30 Jun. 1973 93 p refs
(Grant NGL-24-005-263)
(NASA-CR-135565) Avail: NTIS HC \$6.75 CSCL 08F.

Summaries covering the use of ERTS data to aid in determining surface water transport in lakes, defoliation of crops, air pollution, and snowmelt floods in Minnesota are presented.

N73-32268* Minnesota Univ., Minneapolis. Coll. of Forestry. **AERIAL PHOTOGRAPHY: USE IN DETECTING SIMULATED INSECT DEFOLIATION IN CORN**

H. C. Chiang, Robert Latham, and Merle P. Meyer. In *Its A study of Minn. Forests and Lakes using Data from ERTS* 30 Jun. 1973 p 71-78 refs. Repr. from J. Econ. Entomol., v. 66, no. 3, Jun. 1973 p 779-784.

(Paper-8078) CSCL 02C

Artificial defoliation in corn was used to explore the usefulness of aerial photography in detecting crop insect infestations. Defoliation on the top of plants was easily detected, while that on the base was less so. Aero infrared film with Wratten 89B filter gave the best results, and morning flights at the scale of 1:15840 are recommended. Row direction, plant growth stage, and time elapse since defoliation were not important factors.

Author

N73-32275* Texas A&M Univ., College Station. Remote Sensing Center.

MICROWAVE EMISSION AND SCATTERING FROM VEGETATED TERRAIN

Terrell Gene Sibley Aug. 1973 162 p refs

(Grant NGL-44-001-001)

(NASA-CR-135593; RSC-44) Avail: NTIS HC \$10.25 CSCL 08F

Models are developed for the apparent temperature and backscattering coefficient of vegetated terrain to illustrate the effects of vegetation on the sensitivity of these parameters to variations of soil moisture. Three types of terrain are simulated for both the passive and the active case: a uniform canopy over a smooth surface, plant rows on a smooth surface, and plant rows on a rough surface. In each case the canopy is defined by its overall dimensions and by its electric permittivity, which is determined from Weiner model for dielectric mixture. Emission and scattering from both the soil and the canopy are considered, but atmospheric effects are neglected. Calculated data indicate that the sensitivity of the apparent temperature and backscattering coefficient to variations of soil moisture, decreases as the amount of vegetation increases. It is shown that the same effect results from increasing signal frequency or angle of incidence.

Author

N73-32309* Army Electronics Command, Fort Monmouth, N.J.

THE POTENTIAL USE OF POLARIZED REFLECTED LIGHT IN THE REMOTE SENSING OF SOIL MOISTURE

Barry Doll Jul. 1973 20 p refs

(DA Proj. 170-61102-B-53-A-17)

(AD-785421; ECOM-5501) Avail: NTIS CSCL 08/13

Polarization of light reflected from soil and sand samples is studied as surface moisture and texture of the samples are varied. A reflectometer equipped with a rotating analyzer records the polarization percentage of the reflected light. The percentage of polarization runs from 15.5% for dry soil to 89% for saturated soil, indicating that the polarization method may be viable as a remote sensing system for determining soil moistures. Background on the methods and implications of the results are presented.

Author (GRA)

N73-33244* Nuclear Research Center, Athens (Greece).

APPLICATION OF ERTS-1 IMAGERY TO LAND USE, FOREST DENSITY AND SOIL INVESTIGATIONS Progress Report, Dec. 1972 - Jul. 1973

Nicholas J. Yassoglou, Principal Investigator 25 Aug. 1973 37 p Sponsored by NASA ERTS

(E73-10988; NASA-CR-133767) Avail: NTIS HC \$4.00 CSCL 02F

The author has identified the following significant results. Photographic and digital imagery obtained by ERTS-1 was analyzed and assigned to land features related to agricultural and forest resources. Land use and forest site evaluation maps were prepared by comparing remote sensing and ground truth data. Relationships found in this investigation between spectral signatures recorded by ERTS-1 and land features can be used for the assessment and development of agricultural and forest resources. The results are applicable to areas with ecological and geological conditions similar to those of Greece.

N73-33251* Tennessee Univ., Knoxville. Dept. of Electrical Engineering.

ERTS-1 IMAGERY INTERPRETATION TECHNIQUES IN THE TENNESSEE VALLEY Progress Report, 25 Mar. - 25 Sep. 1973

Robert E. Bodenheimer, Principal Investigator Oct. 1973 10 p ERTS

(Contract NAS5-21875)

(E73-11089; NASA-CR-135557) Avail: NTIS HC \$3.00 CSCL 05B

The author has identified the following significant results. Significant findings are presented which demonstrate the feasibility of delineating major terrain features, land uses, and crop species through computerized analyses. Delineation of features are presently restricted to unsurveyed areas within the same scene as the test sites. Channel 6 appears to give or contain the most information for making feature separations of cropland, pasture, forest, and water.

N73-33258* Kansas Univ. Center for Research, Inc., Lawrence. Atmospheric Science Lab.

DETECTION OF MOISTURE AND MOISTURE RELATED PHENOMENA FROM SKYLAB Monthly Progress Report, Sep. 1973

Joe R. Eagleman, Ernest C. Pogge, Richard K. Moore, Principal Investigators, Norman Hardy, Wen Lin, and Larry League Sep. 1973 3 p EREP

(Contract NAS9-13273)

(E73-11101; NASA-CR-135570) Avail: NTIS HC \$3.00 CSCL 08H

N73-33267* Pennsylvania State Univ., University Park. Space Science and Engineering Lab.

SURVEY AND INVENTORY OF FOREST RESOURCES Interim Report

George J. McMurtry, Gary W. Petersen, Principal Investigators, B. J. Turner, and D. L. Williams May 1973 14 p ref ERTS

(Contract NAS5-23133)
(E73-11110; NASA-CR-135579; ORSER-SSEL-TR-16-73) Avail: NTIS HC \$3.00 CSCL 02F

N73-33278* Nebraska Univ., Lincoln.

PROPOSAL TO EVALUATE THE USE OF ERTS-A IMAGERY IN MAPPING AND MANAGING SOIL RANGE RESOURCES IN THE SAND HILLS REGION OF NEBRASKA Progress Report, 1 Jul. - 30 Aug. 1973

James V. Drew, Principal Investigator 12 Oct. 1973 9 p ERTS

(E73-11121; NASA-CR-135659) Avail: NTIS HC \$3.00 CSCL 08B

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The author has identified the following significant results. Delineation of soil associations of McPherson County was accomplished with MSS band 5 image 1025-16554 and MSS band 6 image 1170-17020. Image 1025-16554 provided delineation of associations where subirrigated meadows and cultivated fields were the predominant features. Image 1170-17020 which is winter imagery with snow cover and low sun angle delineated those associations which were significantly different in topography.

N73-33280*# Mississippi State Univ., State College Inst for Environmental Studies.

A STUDY OF THE APPLICATION OF SKYLAB EREP DATA TO AGRICULTURE IN THE MISSISSIPPI DELTA ALLUVIAL PLAINS REGION Quarterly Report, 23 Jul. - 23 Oct. 1973 C. W. Bouchillon, Principal Investigator 23 Oct. 1973 5 p EREP

(Contract NAS9-13363)

(E73-11125; NASA-CR-135663; QR-2) Avail: NTIS HC \$3.00 CSCL 02C

N73-33288*# Natural Resources Management Corp., Berkeley, Calif. Research and Development Div.

INVESTIGATION OF THE DETECTION AND MONITORING OF FOREST INSECT INFESTATIONS IN THE SIERRA NEVADA MOUNTAINS OF CALIFORNIA Progress Report, 1 Aug. - 30 Sep. 1973

Ralph C. Hall, Principal Investigator 30 Sep. 1973 5 p ERTS

(Contract NAS5-21770)

(E73-11133; NASA-CR-135680; NRM-1) Avail: NTIS HC \$3.00 CSCL 02F

N73-33299*# Mekong Committee Secretariat, Bangkok (Thailand).

AGRICULTURE/FORESTRY, METEOROLOGY, HYDROLOGY Final Report, Jul. 1972 - Aug. 1973

W. J. VanderOord, Principal Investigator 23 Aug. 1973 11 p Sponsored by NASA Original contains imagery. Original

photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(E73-11145; NASA-CR-135710) Avail: NTIS HC \$3.00 CSCL 05B

N73-33309*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

EVALUATION AND COMPARISON OF ERTS MEASUREMENTS OF MAJOR CROPS AND SOIL ASSOCIATIONS FOR SELECTED SITES IN THE CENTRAL UNITED STATES Progress Report, 1 Jan. - 30 Jun. 1973

Marion F. Baumgardner, Principal Investigator Aug. 1973 17 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21785)

(E73-11155; NASA-CR-135743) Avail: NTIS HC \$3.00 CSCL 08M

N73-33316*# California Univ., Berkeley. Center for Remote Sensing Research.

AGRICULTURAL INTERPRETATION TECHNIQUE DEVELOPMENT Quarterly Progress Report

Robert N. Colwell, Andrew S. Benson, Principal Investigators, and James D. Nichols 31 Aug. 1973 12 p EREP

(Contract NAS2-7567)

(E73-11163; NASA-CR-135757) Avail: NTIS HC \$3.00 CSCL 02C

N73-33319*# Montana Univ., Missoula. Montana Cooperative Wildlife Research Unit.

AN EVALUATION OF THE USE OF ERTS-1 SATELLITE IMAGERY FOR GRIZZLY BEAR HABITAT ANALYSIS Progress Report

Joel R. Varney, John J. Craighead, and Jay Sumner 28 Aug. 1973 33 p refs

(Grant NGR-27-002-008)

(NASA-CR-135776) Avail: NTIS HC \$3.75 CSCL 06C

Multispectral scanner images taken by the ERTS-1 satellite in August and October, 1972, were examined to determine if they would be useful in identifying and mapping favorable habitat for grizzly bears. It was possible to identify areas having a suitable mixture of alpine meadow and timber, and to eliminate those which did not meet the isolation requirements of grizzlies because of farming or grazing activity. High altitude timbered areas mapped from satellite imagery agreed reasonably well with the distribution of whitebark pine, an important food species. Analysis of satellite imagery appears to be a valuable supplement to present ground observation methods, since it allows the most important areas to be identified for intensive study and many others to be eliminated from consideration. A sampling plan can be developed from such data which will minimize field effort and overall program cost.

Author

02

ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

Includes land use analysis, urban and metropolitan studies, environmental impact, air and water pollution, geographic information systems, and geographic analysis.

A70-22262 Coastal and urban surveys with IR. Wm. Adams, L. Lepley, C. Warren, and S. Chang (Hawaii, University, Honolulu, Hawaii). *Photogrammetric Engineering*, vol. 36, Feb. 1970, p. 173-180. 12 refs.

Description of remote-sensing research involving real-time imagery of thermal anomalies with an air-borne scanner. The main effort was directed to a study and development of techniques in geophysical exploration for water-resources research utilizing the 3 to 5.5-micrometer band of infrared real-time imagery. An infrared scanner covering the 2 to 5-micrometer wavelength region was flown over the coastline of the Puna and Kau Districts on the island of Hawaii. Only a 5 x 5 deg lens (narrow-angle) was available; hence the flight line had to be at an altitude of 11,000 ft in order to make each image about 1100 ft on a side. A few areas were mosaicked and mounted on aerial photographs to facilitate interpretation. Thermal anomalies were easily identifiable on early morning images, but not during midday hours, as no filter was used. (Author)

A70-22875 * # The problems and potential in monitoring pollution from satellites. A. R. Barringer, J. H. Davies, and A. J. Moffat (Barringer Research, Ltd., Rexdale, Ontario, Canada). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-305*. 16 p. 8 refs. Members, \$1.00; nonmembers, \$1.50. Research supported by the National Research Council of Canada and NASA.

Study of the feasibility of monitoring some forms of air pollution from orbiting spacecraft, with outline of problems connected with scattering effects in the atmosphere. A particularly severe problem is the case of sulfur dioxide when measured in the ultraviolet, due to attenuation of UV light by the ozoneosphere. Difficulties are decreased in the visible spectrum when measuring nitrogen dioxide and the halogens, and become even less of a problem in the near infrared. Considerable success has already been achieved in test programs in high altitude aircraft. Some details of stratospheric balloon tests are presented. A number of optical correlation techniques are being studied for application in the remote sensing of pollutant gases, and there appears to be no major impediment to constructing a space qualified experiment for this purpose. Satellite surveys are capable, with appropriate data handling, of giving an entirely new look at global air pollution.

F.R.L.

A70-22876 # Automatic change discrimination as an aid to city planning. J. G. Kawamura (TRW Systems Group, Redondo Beach, Calif.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-311*. 8 p. Members, \$1.00; nonmembers, \$1.50.

A digital computer is programmed to detect changes of interest in two aerial photographs of the same region taken at different times. A sample set of 125 cell pairs, of which 36 contain changes of interest, is selected from the photograph pair. Three features are extracted from each pair of photograph cells. The feature vectors are displayed in scatter diagrams of the three components taken two at a time. It is found that the features of average entropy change per

pixel in conjunction with the change in high intensity probability per pixel provide the most effective clustering of the change and no change classes. Using a classificatory procedure based on Bayes's strategy, the system effectiveness is estimated to be 22% probability of false dismissal and 7% probability of false alarm. (Author)

A70-23603 * Polarization of reflected solar radiation over land, sea and cloud surfaces. T. A. Hariharan (California, University, Los Angeles, Calif.). *Pure and Applied Geophysics*, vol. 77, no. 6, 1969, p. 151-158. Grant No. NGR-05-007-041.

Results of the measurements of the polarization of reflected solar radiation in the visible region over various land, sea, and cloud surfaces carried out from a high altitude aircraft are presented. It is shown that the measurable polarization can be used as a sensitive parameter to determine atmospheric turbidity and the aerosol content. (Author)

A70-24738 Cornell aerial photo inventories of urban land use and natural resources. John T. Roach (Cornell University, Ithaca, N.Y.). In: *American Society of Photogrammetry, Annual Meeting, 36th, Washington, D.C., March 1-6, 1970, Technical Papers*. Falls Church, Va., American Society of Photogrammetry, 1970, p. 351-362.

A combination of expertise in many fields has recently allowed the Center for Aerial Photographic Studies at Cornell University to conduct two innovative and detailed comprehensive surveys of areas of 1,000 and 50,000 square miles. The aerial photo was the basic information source. Simple, but effective, data collection, manipulation, and presentation methods have been developed. The inventory methods allow inclusion of a wide range of non-aerial photo information; use of the computer in compilation, analysis and display of the data; and, in the future, rapid updating of the data and use of other types of remote sensing. (Author)

A70-24740 Remote detection of oil pollution within the 8-14 micron infrared region. Philip B. Chandler (North American Rockwell Corp., Downey, Calif.). In: *American Society of Photogrammetry, Annual Meeting, 36th, Washington, D.C., March 1-6, 1970, Technical Papers*. Falls Church, Va., American Society of Photogrammetry, 1970, p. 405-421. 10 refs.

Oil slicks in harbors and open sea environments along the Southern California coast have been observed by the North American Rockwell (NR) remote sensing aircraft on several occasions. At the time of detection, an 8-14 micron infrared mapper, a 19.35 GHz microwave radiometer, aerial cameras, and a multiband video system were utilized. However, best definition of oil slicks was within the 8-14 micron thermal infrared region, with the microwave radiometer also exhibiting strong anomalies over the oil. The anomalous cold response of oil covered water in the 8-14 micron band appears to be due to the large difference between the thermal conductivities of water and oil. Thermal gradients within a slick appear to result from a dependence of emissivity on thickness which pertains to semi-transparent bodies such as oil. Hence it is felt that oil slick volume may be easier to estimate using the 8-14 micron thermal region than with conventional aerial photography. However, before such a technique can be considered operational, detailed investigations into the nature and interaction of numerous environmental and physical parameters of an oil/sea system are needed. (Author)

A70-24755 Determination of concentration of polluted air by photogrammetry. S. A. Veress (Washington, University, Seattle, Wash.). In: *American Society of Photogrammetry, Annual Meeting, 36th, Washington, D.C., March 1-6, 1970, Technical Papers*. Falls Church, Va., American Society of Photogrammetry, 1970, p. 729-749. 19 refs.

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The theoretical concept of photographing a polluted air mass is given accompanied by actual examples. The methods of producing a topographic type map from a polluted air mass are given with respect to the two types of aerial photographs used: vertical and oblique. The accuracies obtained from these maps have proved to be acceptable for an air pollution survey. The air mass was traversed by a nephelometer, thereby obtaining the extinction coefficient. The extinction coefficient of any point was computed from the relation between the extinction coefficient measured by a nephelometer and the density of the photographs obtained by a microdensitometer. From these data a computerized density map was obtained. The advantages and disadvantages of methods used in this research are discussed. (Author)

A70-26907 # Extraction of urban data from high and low resolution images. Duane F. Marble (Northwestern University, Evanston, Ill.) and Frank E. Horton (Iowa, University, Iowa City, Iowa). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 2. Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 807-818. 5 refs.

Description of the results of a study of the measurement of the quality of the American urban residential environment. The results of the investigation, coupled with preliminary results from other studies currently underway, lead to a set of preliminary conclusions pertaining to the nature of the tradeoff curves which exist between information level and image resolution level in the urban context. The conclusions drawn are: (1) urban data users constitute a very large group and the leverage of urban data is exceedingly large; (2) nearly all present urban data demands are for classes of information which may be obtained only from high resolution imagery; (3) attempts to use low resolution imagery to satisfy existing urban data demands will decrease the number of potential users to the point where remote sensors may no longer be economically viable as data sources; and (4) any effort to restructure existing urban analysis and planning systems so as to permit the effective use of low resolution imagery will involve a level of effort several times as great as would be necessary to provide high resolution imagery that would be basically compatible with existing demands. M.M.

A70-26908 # Urban spatial structure based on remote sensing imagery. Robert K. Holz, David L. Huff, and Robert C. Mayfield (Texas, University, Austin, Tex.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 2. Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 819-830. Research supported by the Association of American Geographers.

Investigation of the possibility that observable phenomena determined solely from imagery secured by remote sensing could be incorporated into formal constructs designed to predict structural characteristics of urban areas. More specifically, the objective of the study was to determine whether or not such phenomena as built-up area, highway and rail linkage, and rail linkages and distance to nearest larger centers can be incorporated into formal constructs designed to predict structural characteristics of urban areas. The results obtained, although encouraging, showed the existence of a number of relationships which needed more detailed study before any general conclusions can be made. M.M.

A70-26909 # The role of space photography in urban and transportation data series. Barry S. Weller (Kansas, University, Lawrence, Kan.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 2. Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 831-854. 26 refs. U.S. Geological Survey Contract No. 14-08-0001-10654.

Examination of Gemini XII photographs of Houston and San Antonio, Texas, and environs, for their urban and transportation data content. A model of a specific form is advanced as one way of appreciating the role of space photography in a coordinated and integrated set of components relating demand and supply of urban and transportation data. M.M.

A70-26912 # APQ-97 imagery of New England - A geographic evaluation. Robert B. Simpson (Dartmouth College, Hanover, N.H.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 2. Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 909-925.

Evaluation of certain K-band imagery of New England, examining especially its capability to reveal size, shape and distribution of built-up areas. Thirty-eight experienced interpreters from campuses, industry and government supplied their interpretations of three samples of the imagery. The following populational conclusions are drawn: (1) radar imagery of this type reveals to typical competent interpreters 78% of the populated places of New England, including all cities over 7,000 population; more than 80% of towns having 800 to 7,000 people; and 50% of the hamlets of 150 to 800 people; (2) using a more rigorous scoring method, radar permits good interpreters to find more than 4 populated places, down to nameless hamlets of 150 persons, correctly for every error; and (3) the radar permits one to distinguish between built-up and nonbuilt-up squares on finely gridded imagery with 90 to 96% success for predominantly rural areas, and with 62% success for the urban sprawl of outer Boston. M.M.

A70-26950 * # Recent progress in the remote detection of vapours and gaseous pollutants. A. J. Moffat and A. R. Barringer (Barringer Research, Ltd., Rexdale, Ontario, Canada). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 1.

Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 379-413. 8 refs. NASA-supported research.

Discussion of recent advances in the design of a particular type of correlation spectrometer and of preliminary results of a high altitude balloon experiment over Chicago. Advances are described which enable accurate quantitative measurements of diffused atmospheric gases to be made using controlled light sources, accurate quantitative measurements of gas clouds relative to background using solar illumination and measurements of well diffused atmospheric gases using solar illumination. Specific applications of these techniques are described including preliminary results of a high altitude balloon experiment designed to test the feasibility of measuring pollution at the earth's surface from high altitude balloons and satellites. G.R.

A70-29106 * Infrared spectroscopy and infrared lasers in air pollution research and monitoring. Philip L. Hanst (NASA, Electronics Research Center, Cambridge, Mass.). *Applied Spectroscopy*, vol. 24, Mar.-Apr. 1970, p. 161-174. 24 refs.

The use of spectroscopic methods in the analysis of the atmosphere is discussed. The special advantages of infrared vibration-rotation spectra for identification and measurement of air pollutants are emphasized. The capabilities of lasers in atmospheric work are reviewed, with particular attention being given to proposed methods of detecting pollutants by absorption of selected IR laser lines. Some commentary is presented on current and future atmospheric studies. (Author)

A theory is developed which explains the measured spectra as due to the production of density fluctuations by the interaction of the gradient of the mean density with the fluctuations of the turbulent velocity field in the low wavenumber or source region, and viscous dampening of the density fluctuations in the high wavenumbers. The velocity energy spectrum is assumed 'inertial' and isotropic over the total spectral range of the measurements. The measured time dependent spectrum of the contaminant fluctuation is explained as primarily due to the time rate of change of the mean density distribution. Several examples for altitudes from 50 km and upwards are presented. (Author)

A70-30976 Remote sensing for land-use studies. Nelson R. Nunnally (Illinois, University, Urbana, Ill.) and Richard E. Witmer. *Photogrammetric Engineering*, vol. 36, May 1970, p. 449-453. 11 refs.

Development of a system for classifying land use as interpreted from remote sensor imagery. The various types of problems the interpreter faces are examined in detail, and it is shown how the proposed system makes it possible to solve these problems. M.V.E.

A70-33018 Remote Raman measurement of contaminants in air. T. Hirschfeld and S. Klainer (Block Engineering, Inc., Cambridge, Mass.). In: *Laser applications in the geosciences*; Douglas Advanced Research Laboratories, Symposium, Huntington Beach, Calif., June 30-July 2, 1969, Proceedings. Edited by J. Gauger and F. F. Hall, Jr. North Hollywood, Calif., Western Periodicals Co., 1970, p. 69-78.

Discussion of the use of Raman techniques for measuring contaminants in air taking into consideration advances in electro-optical technology and in data processing procedures. Atmospheric scattering as a function of wavelength and meteorological visibility is examined and design considerations for a remote Raman spectrometer are discussed. It is concluded that remote Raman spectroscopy can provide three-dimensional mapping of air pollutants. G.R.

A70-30978 Census analysis and population studies. L. Alan Eyre, Blossom Adolphus, and Monica Amiel (Florida Atlantic University, Boca Raton, Fla.). *Photogrammetric Engineering*, vol. 36, May 1970, p. 460-466. 5 refs.

Review of the utilization of both time-sequence vertical (aerial) photography and census material in an analysis of certain features of the population of Jamaica. It is shown that each can be used to enhance the utility of the other. Examples are given where aerial photography increased the validity of the census and detected inadequacies. Problems associated with the use of aerial photography in census work are discussed. M.V.E.

A70-39126 Remote Raman spectroscopy as a pollution radar. T. Hirschfeld and S. Klainer (Block Engineering, Inc., Cambridge, Mass.). *Optical Spectra*, vol. 4, July-Aug. 1970, p. 63-66. 5 refs.

Consideration of the advantages of Raman spectroscopic methods over other remote techniques in identifying and mapping air pollutants. The integration of high powered lasers with specialized optics and electronics makes it possible to perform qualitative and quantitative analysis of remote species using Raman techniques. In addition to combining a chemical analysis capability with the remote mapping ability of lidar (optical radar), Raman spectroscopy can discriminate between particle scattering and overall atmospheric density by measuring the nitrogen molecular density. F.R.L.

A70-31234 * Application of remote sensors to the classification of aerial data at different scales - A case study in housing quality. Eric G. Moore (Northwestern University, Evanston, Ill.). *Remote Sensing of Environment*, vol. 1, Mar. 1970, p. 109-121. 25 refs. NASA-supported research.

Discussion of techniques by which a classification of aerial data concerning housing quality based on observations of a large number of variables can be approximated by a set of observations of smaller numbers of variables. A strategy is outlined for identifying the scale and the variable set for which remote sensing techniques can achieve an acceptable level of performance in meeting the requirements of an assignment. The results are applied to the problem of assignment of housing aggregates to quality classes. Implications of the results of this study for the existing methods of classification are also considered. V.Z.

A70-40321 Orbital photos applied to the environment. Frank J. Wobber (Earth Satellite Corp., Washington, D.C.). *Photogrammetric Engineering*, vol. 36, Aug. 1970, p. 852-864. 9 refs.

Analysis of photography taken from test rockets and Gemini and Apollo manned spacecraft are useful for demonstrating the advantages and limitations of using small-scale or low-resolution images for studying environmental problems. As cities evolve into megalopolis, it is necessary to recognize the correspondingly wider scope of environmental data needs and apply techniques with an inherent capability for regional synthesis. As a potential source of environmental data, orbital photography provides data contributing to studies of air quality, water quality and socio-economic problems. (Author)

A70-31688 # Turbulence spectra observed in passive contaminant gases in the upper atmosphere. S. P. Zimmerman (USAF, Cambridge Research Laboratories, Bedford, Mass.), C. A. Trowbridge, and I. L. Kofsky (PhotoMetrics, Inc., Lexington, Mass.). *COSPAR, Plenary Meeting, 13th, Leningrad, USSR, May 20-29, 1970, Paper*. 20 p. 9 refs.

The turbulence spectra of passive contaminants, deposited in the upper atmosphere by rockets launched from Eglin AFB, Florida, and Kauai, Hawaii in 1968 and 1969, are measured from radiometrically calibrated photographs of the chemical puffs and trails. The spectra of the passive scalars, for various times after the release, demonstrates a decaying inertiallike, or $-5/3$, subrange at high wavenumber, with a transition at smaller wavenumbers to a -3 spectral dependence.

A70-41402 Soil science and climatology as aids for distinguishing archeological features in aerial photographs (Bodenkunde und Klimatologie als Faktoren zur Erfassung archäologischer Merkmale auf Luftbildern). Anne-Marie Martin (Rheinisch-Westfälische Hochschule, Aachen, West Germany). *Bildmessung und Luftbildwesen*, vol. 38, Sept. 1, 1970, p. 307-310. 7 refs. In German.

02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

Discussion of the requirements peculiar to Central Europe for archeological site location by means of aerial photography. The soil over most archeological sites in Central Europe has long since been tilled flat. Therefore, most clues to ancient road and settlement locations become apparent only at certain seasons in the form of soil and vegetation features. And since vegetation is subject to climatic fluctuations, efficiency requires that the interaction of soil and climate be adequately accounted for in every archeological application of aerial photography. Illustrated examples are discussed.

(Author)

A70-42944 * #. Infrared spectral studies of peroxyacetyl nitrate (PAN). Inge Fild and D. J. Lovell (Massachusetts, University, Amherst, Mass.). *Optical Society of America, Journal*, vol. 60, Oct. 1970, p. 1315-1318. 5 refs. Grant No. NGR-22-010-042; Contract No. N 00014-67-A-0230-0002.

Through a photochemical reaction of nitrogen dioxide and 2-trans-butene, peroxyacetyl nitrate (PAN) is formed, which plays an important role in polluted air. The decomposition of this has been studied under two conditions: continued irradiation and in the absence of further irradiation. It was found that the rate of decomposition differed markedly in these two conditions. Different reaction mechanisms are postulated to account for this difference.

(Author)

A70-44664 # Applications of earth resources survey to the monitoring of the environment. William O. Davis (ESSA, Office of Plans and Programs, Washington, D.C.). *International Astronautical Federation, International Astronautical Congress, 21st, Konstanz, West Germany, Oct. 4-10, 1970, Paper*. 20 p.

Discussion of the U.S. Earth Resources Survey Program as a contributor to the preservation of the terrestrial environment of human life on earth. Special attention is given to Geostationary Operational Environmental Satellite (GEOS) system designed to produce multi-spectral images of most of the Western Hemisphere at night and day half-hour intervals. Future implications of this technique to the monitoring and preservation of the environment is evaluated, covering the prediction of river flows for water management purposes, with timely warning of dangerous floods; the sea surface temperature distribution surveys facilitating weather forecasts; water pollution studies and oceanographic research; and the obtaining of a high-resolution synoptic framework. Several representative aerial photographs are appended to illustrate these applications.

V.Z.

A71-11689 # Possibilities of studying atmospheric pollution with the aid of satellites (Vozmozhnosti izucheniia atmosferynykh zagryaznenii s pomoshch'iu sputnikov). K. Ia. Kondrat'ev (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR). *Meteorologiya i Gidrologiya*, Sept. 1970, p. 3-9. 8 refs. In Russian.

Review of Soviet and foreign studies concerning the use of artificial earth satellites in determining gaseous pollutants in the atmosphere by spectral analysis of outgoing thermal radiation. An analysis of available data suggests the effectiveness of this approach in determining SO₂, CO, CO₂, nitrogen oxides, hydrocarbons and aerosols in the atmosphere. Effective approaches to this problem involving satellite thermal sounding techniques are discussed.

V.Z.

A71-14821 Application of space technology to atmospheric pollution measurement. R. S. Wiltshire and W. H. Clohesy (Martin Marietta Corp., Denver, Colo.). In: *Space technology and earth problems*; American Astronautical Society, Symposium, Las Cruces, N. Mex., October 23-25, 1969, Proceedings.

Edited by C. Q. Ford. Tarzana, Calif., American Astronautical Society (AAS Science and Technology Series, Volume 23), 1970, p. 49-58.

Discussion of the use of spacecraft-mounted instruments for providing a total integrated view of atmospheric pollution. It is shown that air pollution has two aspects: local short-term effects and slowly developing but persistent global effects. A research program is suggested for understanding, measuring, and controlling long-term effects of atmospheric pollution. The principal species of molecules, dust, and aerosols that are polluting the air are identified. It is suggested that their diffusion in the atmosphere and the resultant long-term change in that atmosphere should be determined by means of add-on instruments to many already planned earth orbital satellites. It is also suggested that some agency be charged with the gathering, storing, and analysis of the data obtained.

Z.W.

A71-16045 # Geography of the infrared emission layers in the upper atmosphere (according to Cosmos 65 data) (O geografii sloev infrakrasnogo izlucheniia verkhnei atmosfery po dannym ISZ 'Kosmos-65'). M. N. Markov. *Kosmicheskii Issledovaniia*, vol. 8, Nov.-Dec. 1970, p. 904-914. 16 refs. In Russian.

Analysis of the results of an experiment performed on board Cosmos 65 on Apr. 17, 1965 at heights between 90 and 300 km. It is found that upper atmospheric regions generating IR radiation are nonuniformly distributed over the earth's globe. These regions are to be found at equatorial, polar and mid-latitudes but mostly in the equatorial region. In the case of an unperturbed atmosphere (Kp = 0), the area covered by these generating regions is roughly equal to one tenth of the earth's surface. The generating regions have a stratified structure, the strata varying in thickness from 5 to 30 km. Ray structures are encountered in the polar regions. A substantial contribution of electric fields to the generation of IR radiation in the upper atmosphere is revealed.

V.P.

A71-19080 # Airborne measurement, key to environmental management. W. L. Dowdy and R. L. Gorham (North American Rockwell Corp., El Segundo, Calif.). *(Society of Experimental Test Pilots, Symposium, 14th, Beverly Hills, Calif., Sept. 24-26, 1970.) Society of Experimental Test Pilots, Technical Review*, vol. 10, no. 2, 1970, p. 23-35.

Airborne surveillance techniques and equipment are discussed for monitoring environmental parameters to provide initial data in a large-scale earth resources management program. Airborne sensors such as aerial cameras, IR scanners, side-looking radars, scatterometers, and spectrometers would be used to measure such diverse parameters as thermal water pollution, extent of crop disease, salinity, and geological structure. Specific tests conducted with a specially equipped D-18 Twin Beechcraft are reviewed, and some problems of pilot training, procedures, and data processing are considered.

T.M.

A71-20884 * Ecological interpretation of data from Nimbus 3 high-resolution infrared radiometer. N. H. MacLeod (NASA, Goddard Space Flight Center, Laboratory for Meteorology and Earth Sciences, Greenbelt, Md.). *Journal of Geophysical Research*, vol. 76, Feb. 20, 1971, p. 1588-1594.

Discussion of daytime data from the infrared radiometer on Nimbus 3 which senses solar radiation, reflected by the earth's surface, in the spectral micrometer range from 0.7 to 1.3. The high resolution and contrast of these data make it possible to map the earth's major hydrologic features and plant distribution. In addition, seasonal variations in vegetative development and hydrologic changes can be extracted from the data. The importance of the data for ecological studies is emphasized.

O.H.

A71-23208 Applications of space and high altitude photography to Interior Department functions. Cecil D. Sapp (Raytheon Co., Alexandria, Va.). In: *American Society of Photogrammetry, Annual Meeting*, 37th, Washington, D.C., March 7-12, 1971, Technical Papers. Falls Church, Va., American Society of Photogrammetry, 1971, p. 79-97. 6 refs.

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Study of the applications of simulated Earth Resources Technology Satellite (ERTS-A) imagery, Apollo 9, and high altitude aircraft photography, focusing upon the activities of the Bureau of Land Management, Indian Affairs, and Reclamation. A compilation of those activities which are amenable to solution through remote sensing technology was prepared. Numerous thematic interpretations illustrating imagery applications in terms of soils, geology, geomorphology, vegetation, and cultural features are presented. A Giannini additive color viewer was used to reconstruct false color images from black and white spectral bands. It is considered that ERTS-A imagery should be useful for Interior tasks and functions requiring areal information rather than point information, while Apollo 9 photography provides useful information for those activities which do not require detailed analysis. High altitude aircraft photography provides substantially more information than was originally anticipated.

F.R.L.

A71-23212 The factor of resolution in land use studies from orbital-acquired imagery. John R. Ratzlaff (Maryland, University, College Park, Md.). In: American Society of Photogrammetry, Annual Meeting, 37th, Washington, D.C., March 7-12, 1971, Technical Papers. Falls Church, Va., American Society of Photogrammetry, 1971, p. 162-173. 13 refs. Research supported by the U.S. Geological Survey.

Discussion of the resolution of orbital-acquired imagery which, in contrast to conventional aerial photography, may be a significantly limiting factor in the application of the data to land use studies. Consideration of the wide variations found in physical and cultural landscapes suggests that a uniform level of information from all environments is not available. Illustration of this variation involves method and classification. Conventional aerial photographs were overlain with transparent grids, simulating ground resolution cells. The number of land use elements contained in each cell was recorded. The land use elements are defined in a land use classification scheme appropriate to thematic mapping.

F.R.L.

A71-23213 Monitoring and reporting change in urban housing and its environment. Barry S. Wellar (Kansas, University, Lawrence, Kan.). In: American Society of Photogrammetry, Annual Meeting, 37th, Washington, D.C., March 7-12, 1971, Technical Papers. Falls Church, Va., American Society of Photogrammetry, 1971, p. 174-203. 36 refs.

Discussion of the acquisition of housing-environment data from remote sensor imagery, placing emphasis on rapid surveys and the timeliness attribute of the data. Alternative methods of data acquisition are considered in the broad context of the development of urban and regional information systems. Guidelines and recommendations are presented for coordinated federal-state-local activities, responsibilities are assigned to each body, and methods of acquiring observations on housing-environment data elements are proposed.

F.R.L.

A71-23214 Toward geographic urban change detection systems with remote sensing inputs. Kenneth J. Dueker and Frank E. Horton (Iowa, University, Iowa City, Iowa). In: American Society of Photogrammetry, Annual Meeting, 37th, Washington, D.C., March 7-12, 1971, Technical Papers. Falls Church, Va., American Society of Photogrammetry, 1971, p. 204-218.

Consideration of the operational problems and conceptual basis of urban change detection systems with remote sensing inputs. Problems related to the kind and type of encoding utilized to translate geographic data into machine readable form, their storage, and retrieval are discussed. Attention is given to definition of research priorities for the active utilization of remote sensing inputs to geographical urban information and change detection systems.

F.R.L.

A71-26490 Institute of Environmental Sciences, Annual Technical Meeting and Equipment Exposition, 17th, Los Angeles, Calif., April 26-30, 1971, Proceedings. Mt. Prospect, Ill., Institute of Environmental Sciences, 1971. 509 p. Members, \$15.; nonmembers, \$20.

Papers related to solid waste management, and ecological water studies and management are presented together with investigations in the fields of corrosion, vacuum - cryogenics, and bioenvironmental engineering. Data reduction and control for vibration, space environmental effects on thermal control, nuclear radiation testing requirements for space power and satellite systems, laboratory management, and illumination - simulation are considered. Environmental testing techniques, air pollution measurement, and problems of education in relation to the environmental challenge are also discussed.

G.R.

A71-26505 * # Description and applications of a computer program for the interpretation of RGA mass spectra. R. W. Babst and J. C. Goldsmith (Sperry Rand Corp., Greenbelt, Md.). In: Institute of Environmental Sciences, Annual Technical Meeting and Equipment Exposition, 17th, Los Angeles, Calif., April 26-30, 1971, Proceedings. Mt. Prospect, Ill., Institute of Environmental Sciences, 1971, p. 234-238. Contract No. NAS 5-8202.

The use of residual gas analyzers (RGA) in connection with the vacuum environmental testing of spacecraft and their subsystems is briefly considered, and the principles of operation of the RGA are described. General computer analysis techniques are examined giving attention to limitations in existing programs. A description of pre-processing steps and program algorithm designed to circumvent the limitations is given. Quantitative and qualitative program tests using known compound mixtures are reported, and the use of the program in spacecraft environmental testing is discussed. The feasibility of an air pollution monitoring system consisting of remote RGAs and a central computer which utilizes the program are also considered.

G.R.

A71-29395 Macro land-use mapping with simulated space photos. Robert D. Rudd (Oregon State University, Corvallis, Ore.). *Photogrammetric Engineering*, vol. 37, Apr. 1971, p. 365-372. 8 refs. Research sponsored by the U.S. Geological Survey Geographic Applications Program.

As satellite imagery of the Pacific Northwest, other than from weather satellites, is not routinely available, a 1:400,000 photo-mosaic was used in simulation to investigate land use mapping potential at such scales. No magnification save that achieved through use of a 2x hand lens was employed in the mapping. A macro land use classification was devised to fit the particular purpose of this investigation. The results from an analysis of error imply substantially greater mapping potential for imagery of this scale than was expected.

(Author)

A71-29397 Land-use classification schemes. James R. Anderson (Florida, University, Gainesville, Fla.). *Photogrammetric Engineering*, vol. 37, Apr. 1971, p. 379-387. 8 refs. Research supported by the U.S. Geological Survey.

The development is discussed of land use classification schemes that could be used with orbital imagery for making thematic maps of land use in the U.S. ranging generally in scale from 1:250,000 to 1:2,500,000. To provide a framework for review and evaluation of some attempts that have been made at developing a suitable land use classification scheme for use with orbital imagery, several criteria are proposed. These criteria are not intended to be all-inclusive or precise enough to give a highly refined evaluation. Several recommendations are presented as guidelines for further study. Finally, two tentative land-use classification schemes are proposed for further testing with orbital imagery.

M.V.E.

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A72-10535 # Oil pollution surveillance. P. B. Chandler (Southern California, University, Los Angeles, Calif.). *ACS, AIAA, EPA, IEEE, ISA, NASA, and NOAA, Joint Conference on Sensing of Environmental Pollutants, Palo Alto, Calif., Nov. 8-10, 1971, AIAA Paper 71-1073*. 9 p. 18 refs. Members, \$1.50; nonmembers, \$2.00.

Techniques are discussed for detecting and determining the extent of oil spills at sea by remote airborne sensors operating in select portions of the spectrum. Striking anomalies were observed in the near ultraviolet, thermal infrared, and microwave regions when aerial sensors were used in surveillance and measurement of the major oil spill of 1969 at Santa Barbara. A preliminary conclusion is made from laboratory and field studies that microwave and infrared responses of oil-covered seawater are functions of the surface oil film thickness. It is felt that infrared scanners are at present the most practical, reliable, and useful instruments of oil spill surveillance.

V.Z.

A72-10536 * # Effects of skylight polarization, cloudiness, and view angle on the detection of oil on water. J. P. Millard and J. C. Arvesen (NASA, Ames Research Center, Moffett Field, Calif.). *ACS, AIAA, EPA, IEEE, ISA, NASA, and NOAA, Joint Conference on Sensing of Environmental Pollutants, Palo Alto, Calif., Nov. 8-10, 1971, AIAA Paper 71-1075*. 8 p. 10 refs. Members, \$1.50; nonmembers, \$2.00.

Three passive radiometric techniques, which use the contrast of sunlight reflected and backscattered from oil and water in specific wavelength regions, have potential application for remote sensing of oil spills. These techniques consist of measuring (1) total radiance, (2) the polarization components (normal and parallel) of radiance, and (3) the difference between the normal and parallel components. In this paper, the best view directions for these techniques are evaluated, conclusions are drawn as to the most promising technique, and explanations are developed to describe why previous total-radiance measurements yielded highest contrast between oil and water under overcast skies. The technique based on measurement of only the normal polarization component appears to be the most promising. The differential technique should be further investigated because of its potential to reduce the component of backscattered light from below the surface of the water. Measurements should be made about 45 deg nadir view angle in the direction opposite the sun. Overcast sky conditions provide a higher intensity of skylight relative to clear sky conditions and a lower intensity of backscatter within the water relative to surface reflectance. These factors result in higher contrast between oil and water under overcast skies.

(Author)

A72-10538 # Remote heterodyne detection of gaseous pollutants with tunable lasers. E. D. Hinkley and R. H. Kingston (MIT, Lexington, Mass.). *ACS, AIAA, EPA, IEEE, ISA, NASA, and NOAA, Joint Conference on Sensing of Environmental Pollutants, Palo Alto, Calif., Nov. 8-10, 1971, AIAA Paper 71-1079*. 2 p. Members, \$1.50; nonmembers, \$2.00. Research sponsored by the U.S. Environmental Protection Agency.

At elevated temperatures, all gases emit characteristic infrared radiation into the environment. By the use of lasers as tunable local oscillators in the infrared heterodyne configuration, remote, passive detection of this emitted radiation can be performed. It appears, for example, that gas concentrations of as low as 10 ppm can be detected in smokestack effluent from a distance of 1 km. The theoretical basis for this type of heterodyne detection will be described, and some preliminary experimental results shown.

(Author)

A72-10540 * # Usefulness of the infrared heterodyne radiometer in remote sensing of atmospheric pollutants. R. T. Menzies and M. S. Shumate (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *ACS, AIAA, EPA, IEEE, ISA, NASA, and NOAA, Joint Conference on Sensing of Environmental Pollutants, Palo Alto, Calif., Nov. 8-10, 1971, AIAA Paper 71-1083*. 5 p. 8 refs. Members, \$1.50; nonmembers, \$2.00.

The application of narrow-band optical receivers to the problem of sensing atmospheric pollution is discussed. The emission/absorption lines of many major atmospheric pollutant molecules overlap the operating frequency bands of CO₂ laser and CO laser heterodyne receivers. Several remote pollution sensing systems which are based upon utilization of these spectral overlaps are described, and an analysis of their potential is presented. The possibility of using other lasers (e.g.: the PbSnTe tunable diode laser) as local oscillators is also considered. Results of laboratory experiments with a CO₂ laser heterodyne radiometer are presented.

(Author)

A72-10541 # Fundamental data for Raman scattering measurements of species concentrations and temperature. M. Lapp, L. M. Goldman, and C. M. Penney (General Electric Co., Schenectady, N.Y.). *ACS, AIAA, EPA, IEEE, ISA, NASA, and NOAA, Joint Conference on Sensing of Environmental Pollutants, Palo Alto, Calif., Nov. 8-10, 1971, AIAA Paper 71-1084*. 7 p. 5 refs. Members, \$1.50; nonmembers, \$2.00.

The sensing of species concentrations and temperatures plays a prominent role in the study of environmental pollution. A research program was conducted to provide fundamental molecular data useful in the evaluation and design of laser Raman scattering probes for measuring these characteristics. Experimental results are given for (1) vibrational Raman scattering cross sections of O₂, N₂, NO, CO, and SO₂, (2) NO₂ fluorescence, and (3) Raman scattering band shapes. It is shown that the shape of the line must be taken into account in Raman scattering constituency measurements at temperatures sufficiently high to produce significant vibrational excitation.

T.M.

A72-10545 # Water quality measurements with airborne multispectral scanners. A. C. Conrod and K. A. Rottweiler (Bendix Corp., Aerospace Systems Div., Ann Arbor, Mich.). *ACS, AIAA, EPA, IEEE, ISA, NASA, and NOAA, Joint Conference on Sensing of Environmental Pollutants, Palo Alto, Calif., Nov. 8-10, 1971, AIAA Paper 71-1096*. 9 p. 7 refs. Members, \$1.50; nonmembers, \$2.00.

Commercial and NASA versions of aerial multispectral scanners, their typical applications, and their ground data stations are discussed. Several modes of data analysis, from direct inspection of imagery to computer processing, are covered. Devices for water quality assessment are reviewed. The uses and limitations of multispectral scanners in water quality assessment and water management are considered. Multiscanner systems are characterized as very useful and versatile in applications for water quality investigations.

V.Z.

A72-10546 * # Rapid assessment of water pollution by airborne measurement of chlorophyll content. J. C. Arvesen, E. C. Weaver, and J. P. Millard (NASA, Ames Research Center, Moffett Field, Calif.). *ACS, AIAA, EPA, IEEE, ISA, NASA, and NOAA, Joint Conference on Sensing of Environmental Pollutants, Palo Alto, Calif., Nov. 8-10, 1971, AIAA Paper 71-1097*. 8 p. 17 refs. Members, \$1.50; nonmembers, \$2.00.

Present techniques of airborne chlorophyll measurement are discussed as an approach to water pollution assessment. The differential radiometer, the chlorophyll correlation radiometer, and an infrared radiometer for water temperature measurements are described as the key components of the equipment. Also covered are flight missions carried out to evaluate the capability of the chlorophyll correlation radiometer in measuring the chlorophyll content in water bodies with widely different levels of nutrients, such as fresh-water lakes of high and low eutrophic levels, marine waters of high and low productivity, and an estuary with a high sediment content. The feasibility and usefulness of these techniques are indicated.

V.Z.

A72-10547 # Multiple scattering of laser light from turbid water. V. L. Granatstein, M. Rhinewine, A. M. Levine (Bell Telephone Laboratories, Inc., Whippany, N.J.), D. L. Feinstein, M. J. Mazurowski, and K. R. Piech (Cornell Aeronautical Laboratory, Inc., Buffalo, N.Y.). *ACS, AIAA, EPA, IEEE, ISA, NASA, and NOAA, Joint Conference on Sensing of Environmental Pollutants, Palo Alto,*

Calif., Nov. 8-10, 1971, AIAA Paper 71-1098. 9 p. 21 refs. Members, \$1.50; nonmembers, \$2.00. Research supported by the Cornell Aeronautical Laboratory.

Through a controlled laboratory study, a theoretical model has been developed which accurately relates the reflectance of turbid water to the concentrations of suspended materials which scatter and absorb light. Such a model will be useful in obtaining a quantitative mapping of pollutant distributions in lakes and rivers from aerial photographic surveys. The extraction of quantitative information from aerial photographs has been hindered in the past by the lack of an accurate model which relates reflectance to pollutant distribution; the required theory is complicated since in general the light is multiply scattered. In the present work, laser light was shone on turbid water containing two species of 'pollutants' - a polydispersion of Teflon particles which scattered the light, and a black dye which absorbed the light. Over a large range of 'pollutant' concentrations, the measured radiance of scattered light was successfully predicted by the theoretical analysis. The theoretical development involved obtaining appropriate solutions of the radiative transport equation, and included modelling of certain special effects such as correlation in scatterings from closely spaced particles. (Author)

A72-10551 * # Pollution detection by digital correlation of multispectral, stereo-image pairs. F. R. Krause (NASA, Marshall Space Flight Center, Huntsville, Ala.), H. T. Betz (IIT Research Institute, Chicago, Ill.), and D. H. Lysobey (Oklahoma, University, Norman, Okla.). ACS, AIAA, EPA, IEEE, ISA, NASA, and NOAA, Joint Conference on Sensing of Environmental Pollutants, Palo Alto, Calif., Nov. 8-10, 1971, AIAA Paper 71-1106. 15 p. 26 refs. Members, \$1.50; nonmembers, \$2.00. NASA-supported research.

Remote detection of air pollution circulation patterns is proposed to eventually predict the accumulation of hazardous surface concentrations in time for preventive emission control operations. Earth observations from space platforms will contain information on the height, mean velocity and lateral mixing scales of inversion layers and pollution plumes. Although this information is often not visible on photographs, it could conceivably be retrieved through a digital cross-correlation of multispectral stereo image pairs. Laboratory and field test results are used to illustrate the detection of non-visual inversion layers, the reduction of dominant signal interference, and the spectroscopic identification of combustion products. (Author)

A72-10552 * # An interim report on remote sensing of environmental pollutants with a Fourier interference spectrometer. R. A. Schindler (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). ACS, AIAA, EPA, IEEE, ISA, NASA, and NOAA, Joint Conference on Sensing of Environmental Pollutants, Palo Alto, Calif., Nov. 8-10, 1971, AIAA Paper 71-1108. 4 p. Members, \$1.50; nonmembers, \$2.00.

A small Fourier interference spectrometer for sensing environmental pollutants from spacecraft has been developed at the Jet Propulsion Laboratory. The instrument is intended for obtaining high spectral resolution infrared absorption spectra in the 1.2 to 5.5 micron region at speeds sufficiently high for medium altitude orbital satellite surveys. The paper reviews basic details of the instrument servo and infrared detection systems, previously described, as well as recent developments. In particular, the data-handling system, data reduction techniques and optical tolerance problems are discussed. Preliminary results are included. (Author)

A72-10553 * # Global studies of atmospheric pollutants and trace constituents. R. A. Toth and C. B. Farmer (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). ACS, AIAA, EPA, IEEE, ISA, NASA, and NOAA, Joint Conference on Sensing of Environmental Pollutants, Palo Alto, Calif., Nov. 8-10, 1971, AIAA Paper 71-1109. 4 p. Members, \$1.50; nonmembers, \$2.00.

A high speed, high resolution, Fourier interferometer operating in the 1 to 5 micron spectral region can best meet the needs for remotely detecting and monitoring various molecular species in the atmosphere. An operational breadboard version of the instrument

exists. Spectra obtained from ground sites in the Los Angeles area demonstrate the presence of several gases in the atmosphere. Two spectra in the 2.1 and 2.3 micron regions respectively are presented from which relative abundances of carbon dioxide and carbon monoxide are derived. Ground based operations and aircraft flights with the present instrument verify the potential operational capacity for a satellite instrument. A discussion is presented on the use of the instrument from a spacecraft. (Author)

A72-10557 * # Carbon monoxide pollution experiment. I - A solution to the carbon monoxide sink anomaly. R. N. Grenda, M. H. Bortner (General Electric Co., Philadelphia, Pa.), P. J. LeBel (NASA, Langley Research Center, Hampton, Va.), J. H. Davies, and R. Dick (Barringer Research, Ltd., Rexdale, Ontario, Canada). ACS, AIAA, EPA, IEEE, ISA, NASA, and NOAA, Joint Conference on Sensing of Environmental Pollutants, Palo Alto, Calif., Nov. 8-10, 1971, AIAA Paper 71-1120. 17 p. 17 refs. Members, \$1.50; nonmembers, \$2.00. NASA-sponsored research.

The observed lack of a high rate of growth in global CO concentration implies that there is some sink mechanism for destroying the CO as rapidly as it is being produced. A program is described which is intended to develop both the experiment concept and the remote sensor required to measure atmospheric CO with sufficient accuracy to locate the sink, whether it be at the earth's surface or in the upper atmosphere. The program calls for the development of a remote sensor which can look for surface sinks by mapping the vertical CO burden in the atmosphere on a daily basis, and which can look for an upper atmospheric sink by means of measurements of total CO in a horizontal path through the limb of the earth's atmosphere, using the sun as the source. T.M.

A72-10559 # The development of a laser fluorosensor for remote environmental probing. R. M. Measures and M. Bristow (Toronto, University, Toronto, Canada). ACS, AIAA, EPA, IEEE, ISA, NASA, and NOAA, Joint Conference on Sensing of Environmental Pollutants, Palo Alto, Calif., Nov. 8-10, 1971, AIAA Paper 71-1121. 8 p. Members, \$1.50; nonmembers, \$2.00.

The first phase of a development programme devoted to the exploitation of laser induced fluorescence for environmental sensing has been completed. A prototype Laser Fluorosensor has been constructed and used to evaluate, in the laboratory, the feasibility of this concept and to explore the potential range of applications. Special attention has been given to assessing the ability of a Laser Fluorosensor to map the extent of an oil slick, locate the source of lignin sulphonate pollution and monitor the dispersal of a tracer dye for hydrologic uses. The preliminary results of our study are encouraging and lead us to predict that a Laser Fluorosensor could be used for environmental sensing from an aircraft. (Author)

A72-11776 * International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volumes 1, 2 & 3. Symposium sponsored by the University of Michigan, the U.S. Environmental Protection Agency, NASA, the U.S. Department of Transportation, the U.S. Geological Survey, the U.S. Air Force, and the U.S. Department of Agriculture. Ann Arbor, University of Michigan, 1971. Vol. 1, 822 p.; vol. 2, 778 p.; vol. 3, 785 p.

The sessions dealt in full detail with basic research in geology and soils; manual interpretation of data on land use, snow, and ice; machine assisted data handling; instrumentation; basic research in water, snow, and ice; manual interpretation of data on vegetation, soils, and geology; user studies and instrumentation; and operational systems.

Individual items are abstracted in this issue.

F.R.L.

A72-11797. # Remote sensing of man-made ecosystems which result from variability of historical and actual human pressure. G. Long, G. Rimbault, and J.-L. Guillermin (CNRS, Centre d'Etudes Phytosociologiques et Ecologiques, Montpellier, France). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceed-

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ings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 395-407. Translation. Research supported by the Centre National d'Etudes Spatiales.

An approach to the study of the biosphere is proposed that gives priority to investigations of the autotrophic vegetation, the first link in the food chain. It is shown that an ecological study in depth of the vegetation may help explain the mechanisms that have led to the present humanized landscape of the vegetation cover in the Old World. M.V.E.

A72-11802 # The use of remote sensing for resource inventory and analysis for multiple use management of semi-arid lands in California. D. H. Gates. In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 487-493. 5 refs.

Description of a program of resource inventory and analysis combining remote sensing techniques and ecological principles in a pilot area of the California Desert. A multistage resource inventory using three scales of imagery was employed, involving photo interpretation and so-called ground truthing to determine the accuracy of the interpretation. Following completion of the field work, all mapping information was transferred from the original aerial photos used for interpretation and ground truthing to a photo mosaic of the pilot area. The advantages and disadvantages of the proposed resource inventory procedures are cited. A.B.K.

A72-11806 # Atmospheric pollution detection by satellite remote sensing. A. McLellan, IV (Wisconsin, University, Madison, Wis.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 563-584.

A feasibility study was made to investigate the possibility of monitoring the variation in turbidity over a city-wide area by means of passive remote sensing from a satellite in earth synchronous orbit. It is shown in this paper that the relative change in sun reflected radiation over the city of Los Angeles, California on 23 April 1968 as measured by the green channel data from the geostationary Application Technology Satellite III located 35,000 kilometers from earth can be correlated with ground-based data, such as local horizontal visibilities and reflectometer measurements of sampled particulate matter. This pilot program opens up the possibility that with the appropriate sensing detectors on board geosynchronous satellites, monitoring of the time and spatial profiles of atmospheric molecular pollutants as well as particulate matter can be achieved over cloud-free areas. (Author)

A72-11816 # The effect of coherence and multiple scattering on laser radar air pollution measurements. H. Sievering and R. Mittra (Illinois, University, Urbana, Ill.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 751-757. 11 refs.

Discrimination of backscatter due to molecular constituents from that due to pollutant particulates may be achieved by utilizing coherence properties of laser radar. It is also shown that multiple scattering does not degrade the laser radar coherence properties for the lower atmospheric studies. (Author)

A72-11827 # Remote sensing for pollution and environmental quality studies. G. W. North (U.S. Geological Survey, Washington, D.C.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 2. Ann Arbor, University of Michigan, 1971, p. 973-987.

Guidelines for conducting regional environmental quality studies are presented with the aim of showing how action can be stimulated to improve environmental quality through collection, analysis, and

use of remotely sensed data. A five-dimensional sensor/applications matrix is described that is designed to guide decisions regarding the role of remote sensors in studies of this kind. The matrix defines an environmental goal, ranks the various remote sensing objectives in terms of their ability to assist in solving environmental problems, lists the environmental problems, ranks the sensors that can be used for collecting data on each problem, and finally ranks the sensor platform options available. By following the guidelines, or variations of them, according to capabilities and resources available, it is possible to carry out simultaneous studies in different areas and have consistent results. Examples of data from a variety of remote sensing instruments and of special processing, enhancement, and analysis techniques are included. M.V.E.

A72-11829 * # Oil slick studies using photographic and multi-spectral scanner data. J. C. Munday, Jr., W. G. MacIntyre, M. E. Penney (Virginia Institute of Marine Science, Gloucester Point, Va.), and J. D. Oberholtzer (NASA, Wallops Station, Wallops Island, Va.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 2. Ann Arbor, University of Michigan, 1971, p. 1027-1043. 36 refs. U.S. Environmental Protection Agency Grant No. 15080EJO; Contract No. NAS6-1902.

Field studies of spills of Nos. 6 (Bunker C), 4, and 2 fuel oils and menhaden fish oil in the southern Chesapeake Bay have been supplemented with aerial photographic and multispectral scanner data. Thin films showed best in ultraviolet and blue bands and thick films in the green. Color film was effective for all thicknesses. Thermal infrared imagery provided clear detection, but required field temperature and thickness data to distinguish thickness/emissivity variations from temperature variations. Slick spreading rates agree with the theory of Fay (1969); further study of spreading is in progress. (Author)

A72-11830 # Multi-sensor oil spill detection. J. C. Aukland (Spectran, Inc., Los Angeles, Calif.), D. T. Trexler (Nevada, University, Reno, Nev.), and F. Orthlieb (U.S. Coast Guard, Washington, D.C.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 2. Ann Arbor, University of Michigan, 1971, p. 1045-1052. Contracts No. DOT-CG-03532-A; No. DOT-CG-11996-A.

The detection and quantization of oil from moving ships at sea are an ever increasing problem. Maximum spill rates have been established which are enforced by the U.S. Coast Guard. To be effective the enforcement agencies must obtain data and records for presentation as legal evidence in a court of law. Two programs on controlled oil spill have been conducted to determine the feasibility of using certain sensors at different wavelengths for the detection and measurement of oil spills from moving ships. The results of those programs are summarized in this paper as well as recommendations for an all-weather oil pollution surveillance system. (Author)

A72-11848 # Remote sensing of Indian resources. A. M. Woll (U.S. Department of the Interior, Bureau of Indian Affairs/EROS, Washington, D.C.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 2. Ann Arbor, University of Michigan, 1971, p. 1437-1441.

Three remote sensing projects being conducted at Indian reservations as a forerunner of Natural Resource Information System under development are discussed. A multiband (thermal and 'false color') sensing of an Englemann Spruce beetle infestation is being conducted at the Fort Apache Reservation. An extensive examination of a circular topographic feature is in progress at the San Carlos Reservation. And potential mineral areas are studied at the Papago Reservation by comparing and correlating space imagery with high-resolution imagery and aeromagnetic data. V.P.

A72-12019 The social-spatial structure as a result of an aerial photographic interpretation of urban geography (Sozial-räumliche Gliederung als Ergebnis stadtgeographischer Luftbildinterpretation). D. Badewitz (Ruhr-Universität, Bochum, West Germany). *Bildmessung und Luftbildwesen*, vol. 39, Nov. 1, 1971, p. 253-261. 18 refs. In German.

Using an aerial photograph of the city of Essen, Germany, an attempt has been made to elaborate a social-spatial pattern of a part of the city. The classification of the social-spatial units is based on an evaluation of land use, urban communication system, distribution of industry, and also individual buildings. Results have been checked using the city directory, and an excellent agreement has been obtained. O.H.

A72-12182 Wideband spectrum utilization above 10 GHz for communications and monitoring the ecology. C. L. Cuccia and J. J. Spilker, Jr. (Philco-Ford Western Development Laboratories, Palo Alto, Calif.). *Microwave Journal*, vol. 14, Nov. 1971, p. 24-26, 28, 30. 19 refs.

Study of the use of the frequency spectrum above 10 GHz for the utilization of the transmission medium at millimeter wave, IR, and optical wavelengths for the transmission of very wide band high data rate digital communications, and the utilization of the spectrum at these frequencies for monitoring the ecology. In general, the spectrum utilization for both digital communications and ecological monitoring differs principally on the basis of what data is being measured. Attention is given to high speed digital communications, passive imaging, active imagery and remote sensing, and the measurement of atmospheric pollutants. F.R.L.

A72-14311 # Large scale aerophototopographic survey of urban areas (O krupnomasshtabnoi aerofototopograficheskoi s'emke zastroennykh territorii). N. A. Sokolova. *Geodeziia i Kartografiia*, vol. 16, no. 10, 1971, p. 41-47. In Russian.

Specific features of buildings as they appear on aerial photographs are examined, and methods of accounting for these features in the preparation of large-scale photomaps are outlined. Some aspects of the application of universal stereophotogrammetric instruments to the surveying of urban areas are discussed. V.P.

A72-14572 Aerial photo-ecology. J. A. Howard (Melbourne, University, Melbourne, Australia). New York, American Elsevier Publishing Co., Inc., 1970. 373 p. 906 refs. \$18.

The physical fundamentals of aerial photography and photogrammetry are explained, together with the general principles of interpretation of the natural environment from aerial survey images. Camera details, film characteristics, processing and printing operations, economic considerations, and experiment planning procedures are reviewed. Characteristics of light reflection by vegetation are outlined, and attention is given to the influence of tropospheric conditions, scattering effects, and visual range limits. Other factors considered include radial displacement, geographic and geologic considerations, and geomorphic aspects. Radial line triangulation, planimetric mapping, stereoscopy, height determinations, and area measurements are explained along with apparent features of forest vegetation in various latitudes. T.M.

A72-15300 * Comparison of laser methods for the remote detection of atmospheric pollutants. H. Kildal and R. L. Byer (Stanford University, Stanford, Calif.). *IEEE, Proceedings*, vol. 59, Dec. 1971, p. 1644-1663. 62 refs. Grant No. NGL-05-020-103; Contract No. N00014-67-A-0112-0044.

Three methods of remote air pollution detection - Raman backscattering, resonance backscattering, and resonance absorption - are discussed and compared. Theoretical expressions are derived for the minimum detectable pollutant concentration, and in each case the depth resolution and the problems of interference, pump depletion, and background noise are discussed. A brief discussion of possible laser sources is included, numerical examples of the detectabilities based on present technology are given. The atmospheric transparency limits the useful range to a few kilometers

for the Raman and resonance backscattering schemes. For the resonance absorption technique the useful range can be as great as 50 kilometers. (Author)

A72-16599 Oil spills, IR and microwave. J. M. Kennedy (TRW Systems Group, Redondo Beach, Calif.) and E. G. Wermund (Remote Sensing, Inc., Houston, Tex.). (Conference on Prevention and Control of Oil Spills, Washington, D.C., June 1971.) *Photogrammetric Engineering*, vol. 37, Dec. 1971, p. 1235-1242. 6 refs.

Geographic surveillance of spills, identification of their sources, and predicting their terminal locations by using airborne infrared and microwave radiometric measurements is discussed. It is shown that these two systems can effectively operate under day and night and relatively bad weather conditions. If operated in concert, they may be used to locate, track, and determine the volume of oil on sea surfaces. In instances of flowing spills, fair estimates of flow rates and the effectiveness of clean-up operations may be determined. Also, the temporal image pattern change may be used effectively to forecast and to reconstruct the surface movements of spills. O.H.

A72-16600 Oil slick remote sensing. J. T. Smith, Jr. (NOAA, National Ocean Survey, Rockville, Md.). *Photogrammetric Engineering*, vol. 37, Dec. 1971, p. 1243-1248.

An oil spill off Cape Hatteras, North Carolina, resulting from the sinking of a tanker, was located and photographed by the National Ocean Survey using its Buffalo photographic aircraft equipped with two aerial cameras and a thermal-IR scanner. The spill was found about 80 nautical miles east-southeast from the reported position of the sinking of the stern section. Probable reasons explaining this phenomenon were examined. It was speculated that the bow of the ship had been carried by ocean currents to its eventual location where it sank and released its cargo of oil. O.H.

A72-16689 * # Airborne optical detection of oil on water. J. P. Millard and J. C. Arvesen (NASA, Ames Research Center, Moffett Field, Calif.). *Applied Optics*, vol. 11, Jan. 1972, p. 102-107. 7 refs.

Airborne measurements were made over controlled oil-spill test sites to evaluate various techniques, utilizing reflected sunlight, for detecting oil on water. The results of these measurements show that (1) maximum contrast between oil and water is in the UV and red portions of the spectrum; (2) minimum contrast is in the blue-green; (3) differential polarization appears to be a very promising technique; (4) no characteristic absorption bands, which would permit one oil to be distinguished from another, were discovered in the spectral regions measured; (5) sky conditions greatly influence the contrast between oil and water; and (6) highest contrast was achieved under overcast sky conditions. (Author)

A72-18229 # Remote sensing and environment protection (Remote Sensing und Umweltschutz). D. Paffrath (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Physik der Atmosphäre, Porz-Wahn, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Fernerkundung der Erdoberfläche, Munich, West Germany, Dec. 9, 1971, Paper 71-132*. 24 p. 12 refs. In German.

Discussion of the benefits derivable from the application of remote sensing methods to problems of environment protection. Following a review of the physical principles and technical implementation of active and passive remote sensing, the problems of pollution monitoring and of environment protection are examined. The problems discussed include: the surveillance, detection measurement, and suppression of air pollutants; meteorological aspects of pollution propagation; acoustic and optical methods of noise measurement; noise abatement; hydrology and water protection; waste disposal; recreation land and nature preservation; in situ measurements and the interpretation of remote sensing data; and impact of new technologies. M.V.E.

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A72-18439 * # Photogrammetric and photometric investigation of a smoke plume viewed from space. D. Randerson (U.S. Department of Commerce, Air Resources Laboratory, Las Vegas, Nev.), J. G. Garcia, and V. S. Whitehead (NASA, Manned Spacecraft Center, Houston, Tex.). *Journal of Applied Meteorology*, vol. 10, Dec. 1971, p. 1122-1131. 11 refs.

Use of detailed analyses of an Apollo 6 stereographic photograph of a smoke plume which originated in southern Arizona and crossed over into Mexico to illustrate how high-resolution photography can aid meteorologists in evaluating specific air pollution events. Photogrammetric analysis of the visible smoke plume revealed that the plume was 8.06 miles long and attained a maximum width of 4000 ft, 3.0 miles from the 570-ft chimney emitting the effluent. Stereometric analysis showed that the visible top of the plume rose nearly 2400 ft above stack top, attaining 90% of this total rise 1.75 miles downwind from the source. Photometric analysis of the plume revealed a field of plume optical density that portrayed leptokurtic and bimodal distributions rather than a true Gaussian distribution. A horizontal eddy diffusivity of about 650,000 sq cm/sec and a vertical eddy diffusivity of 230,000 sq cm/sec were determined from the plume dimensions. Neutron activation analysis of plume samples revealed the elemental composition of the smoke to be copper, arsenic, selenium, indium and antimony, with trace amounts of vanadium and scandium. (Author)

A72-18460 # Performance and comparison of laser radar methods for remote analysis and monitoring of pollutants in the atmosphere. H. Inaba and T. Kobayashi (Tohoku University, Sendai, Japan). In: High frequency generation and amplification: Devices and applications; Proceedings of the Third Biennial Cornell Electrical Engineering Conference, Cornell University, Ithaca, N.Y., August 17-19, 1971. Ithaca, N.Y., Cornell University, 1971, p. 73-83. 27 refs.

In this paper, we report an analytical study of the new family of remote sensing systems which use laser radar techniques for the detection of individual air pollutants. This work covers four of these techniques, Raman, fluorescence and resonance Raman backscatterings, resonance (Rayleigh) scattering, and absorption, and compares these four methods extensively in terms of their functions and performance. The discussion is made on minimum detectable concentration, and range capability of these four schemes. (Author)

A72-18822 # Remote sensing of oil on water using laser induced fluorescence. H. Gross, A. Davis, and J. Kruus (Department of Environment, Ottawa, Canada). *ACS, AIAA, EPA, IEEE, ISA, NASA, and NOAA, Joint Conference on Sensing of Environmental Pollutants, Palo Alto, Calif., Nov. 8-10, 1971, AIAA Paper 71-1076*. 6 p. Members, \$1.50; nonmembers, \$2.00.

Sample spectra obtained in the laboratory of potential targets indicate that good excitation can be expected with a Helium-Cadmium laser operating at 441.6 nanometers. This wavelength represents a compromise between the variety of targets expected and available sources that would lend themselves to airborne use. Ground tests performed at 400 feet range with equipment scheduled for aircraft installation gave good response. (Author)

A72-22313 The use of lasers in pollution monitoring. I. Melngailis (MIT, Lexington, Mass.). (*Institute of Electrical and Electronics Engineers, Annual International Geoscience Electronics Symposium, 3rd, Washington, D.C., Aug. 25-27, 1971.*) *IEEE Transactions on Geoscience Electronics*, vol. GE-10, Jan. 1972, p. 7-17. 47 refs. USAF-supported research.

Optical techniques have opened up new possibilities in air pollution monitoring because of their remote-sensing capability, very high specificity, and short observation time. Techniques involving the use of lasers include Raman scattering, emission either from resonantly excited or from hot gases, and resonant absorption. Unique advantages in these applications are provided by the recently developed tunable lasers, including organic dye lasers, parametric oscillators, spin-flip Raman lasers, and semiconductor lasers. The absorption technique which promises to have the widest range of application has been tested in the laboratory. G.R.

A72-23281 # Form and site of major United States cities on vertical aerial photography. C. Padick (California State College, Los Angeles, Calif.). In: Internationale Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 1. Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 105-110.

Aerial photos of the one hundred largest cities in the United States have been compiled as a means of assisting researchers and instructors in urban geography in individual or comparative city-site and morphological studies. The principal characteristics include site, location of city cores (and avenues of expansion therefrom), orientation of street grids, extent of urbanization, the relative site and shape of the central business district, hindrances to expansion, relative positions of urban functional areas, and transportation networks. V.P.

A72-23293 # Study of a damp wasteland according to the seasons and with various emulsions (Etude selon les saisons et divers émulsions d'une lande humide). M. Girard (Ecole Nationale Supérieure Agronomique, Grignon, Yvelines, France). In: Internationale Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 1. Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 419-431. In French.

Photographic study of a damp wasteland resulting from the cutting down of oak and hornbeam groves. Five units are particularized according to the slope, the wetness of the ground, the presence or absence of trees, and the development of the vegetal carpet. Panchromatic, infrared, color, and false color emulsions corresponding to different seasons, are evaluated for ecological studies. F.R.L.

A72-23296 # The significance of soil science and climatology for the detection of archeological features on aerial photographs (Die Bedeutung der Bodenkunde und Klimatologie zur Erfassung archäologischer Merkmale auf Luftbildern). A.-M. Martin (Rheinisch-Westfälische Technische Hochschule, Aachen, West Germany). In: Internationale Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 1. Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 495-506. 12 refs. In German.

An investigation of the possibilities of low-level aerial photography for archeological searches was conducted. It was found that the time when archeological features can be detected on aerial photographs is determined by the soil type and the climate. Thus, the amount of precipitation within a certain time period is of great importance. A map is presented showing the distribution of archeological sites together with the soil types found on aerial photographs. G.R.

A72-23301 # Environmental applications of thermal imaging. R. W. Stingelin (HRB-Singer, Inc., State College, Pa.) and J. I. Taylor. In: Internationale Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 2. Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 641-644.

Thermal imagery from airborne optical-mechanical line scanning systems is a useful tool to the interpreter in several specific areas of environmental studies. The primary uses of IR imagery in the region from 2 to 14 micrometers are in the detection, mapping, and monitoring of thermal patterns in water bodies, and of anomalous heat manifestations on the land. The IR scanner is also in operational use in combating forest fires and in delineating coal refuse pile and shallow mine fires.

A72-23952 Laser beam technology for remotely sensing invisible molecules in the polluted atmosphere. T. Kobayasi and H. Inaba (Tohoku University, Sendai, Japan). In: Symposium on Electron, Ion, and Laser Beam Technology, 11th, University of Colorado, Boulder, Colo., May 12-14, 1971, Record.

San Francisco, San Francisco Press, Inc.; New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 385-402. 33 refs.

Description of some experimental and theoretical studies on a new family of remote-sensing systems of invisible air pollutants by the application of the laser radar technique. Four schemes are compared extensively in terms of their respective functional capabilities and performances. The Raman backscattering or laser-Raman scheme was demonstrated experimentally to detect specific pollutants in the atmosphere. By incorporating a UV pulsed nitrogen or a Q-switched ruby laser, many molecules including SO₂, NO, CO₂, H₂S, CH₄, CO, and H₂CO in polluted air, as well as N₂, O₂, and H₂O in ordinary air, were identified separately by spectroscopic analysis. The combined scheme of fluorescence and resonance Raman backscattering was examined in the experiment by using a frequency-tunable dye laser pumped by a pulsed nitrogen laser. Besides these two methods, a resonance scattering scheme for detecting metallic vapor pollutants and an absorption scheme for measuring average or total concentrations of atomic and molecular pollutants over the optical path are also discussed. Theoretical expressions are derived for estimating scattering cross section, minimum detectable concentration, and range capability of these four schemes, and comparisons are made. (Author)

A72-24100 # Remote optical sensing for air-pollution monitoring. J. D. Bode and J. P. Carrico (Bendix Research Laboratories, Southfield, Mich.). *Bendix Technical Journal*, vol. 4, Winter 1971, p. 14-28. 25 refs.

Remote optical sensing techniques using light-scattering measurements are discussed as an attractive alternative to on-the-spot measurements in industrial air pollution monitoring. The topics include particle interactions, elastic scattering, absorption and resonance fluorescence, backscattering by particles, inelastic scattering and Raman scattering. Remote sensing system configurations, an absorption-measuring remote sensor for ozone, and remote sensing designs based on elastic scattering and on Raman scattering are discussed. Recently developed high-power lasers are characterized as nearly ideal probes for remote optical monitoring. It is also anticipated that fluorescence light-scattering will provide a very practical technique for chemical pollutant identification. V.Z.

A72-25216 # Measurements of infrared radiation properties of gaseous pollutants by a high temperature, high pressure, long path cell. S. H. Chan, J. F. Moore, M. J. D. Low (New York University, Bronx, N.Y.), and P. S. Jagannathan. *American Institute of Aeronautics and Astronautics, Thermophysics Conference, 7th, San Antonio, Tex., Apr. 10-12, 1972, Paper 72-276*. 5 p. 20 refs. Members, \$1.50; nonmembers, \$2.00. NSF Grant No. GK-24972.

An absorption cell employing multiple-reflection optics has been developed for measuring the IR absorption of gaseous pollutants over wide ranges of temperature (room temperature to 558 K), pressure (vacuum to 3000 lb/sq in), and path distance (4 to 48 meters). Room-temperature measurements at a total pressure of about 1 atm are reported for four different air pollutants. Low-resolution data are given for the most important IR bands of sulfur dioxide, nitric oxide, ethylene, and nitrogen dioxide. T.M.

A72-27948 Multiple scattering of laser light from a turbid medium. V. L. Granatstein, M. Rhinewine (Bell Telephone Laboratories, Inc., Whippany, N.J.), A. M. Levine (Richmond College, New York, N.Y.), D. L. Feinstein (Wisconsin State University, Wis.), M. J. Mazurowski, and K. R. Piech (Cornell Aeronautical Laboratory, Inc., Buffalo, N.Y.). *Applied Optics*, vol. 11, May 1972, p. 1217-1224. 22 refs. Research supported by the Cornell Aeronautical Laboratory.

Through a controlled laboratory study, theoretical modeling was developed that accurately relates the reflectance of turbid water to the concentrations of suspended and dissolved materials; this modeling will be useful in quantitatively mapping pollutant concentrations in lakes and rivers through aerial photography. Laser light illuminated water containing both Teflon particles and black dye. Over a large range of concentrations of these scattering and absorbing materials, measured reflectance was successfully predicted by a multiple scattering analysis. (Single scatter analysis produced serious errors.) The theoretical development involved solving the radiative transport equation and accounted for correlated scattering from closely spaced particles. (Author)

A72-31230 # Setting up test sites for the study of ecological problems via remote sensing techniques (Costituzione di aree pilota per lo studio di problemi ecologici mediante le tecniche di 'remote sensing'). R. Cassinis and A. M. Tonelli (CNR, Laboratorio per la Geofisica della Litosfera, Milan, Italy). In: Space activity in the field of ecology and earth resources; International Convention on Space, 12th, Rome, Italy, March 23-25, 1972, Proceedings.

Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1972, p. 67, 69-72. In Italian.

The reasons and the international programs for simultaneous remote sensing of earth resources and environmental pollution are described. European countries have selected representative test sites for the study of geology, mineralogy, petrography, agriculture, forestry, vulcanology, oceanography and ecology. Italian projects are delineated. B.B.M.

A72-31232 # The potential of space techniques in geoscopy. N. Simmons (Ministry of Defence, London, England). In: Space activity in the field of ecology and earth resources; International Convention on Space, 12th, Rome, Italy, March 23-25, 1972, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1972, p. 109, 111-120.

Attempt to provide a basis for a fruitful confrontation between geoscopy requirements and technical means. User requirements are formulated for ecology and pollution control. This choice has the advantage of highlighting both a positive and a negative 'earth resource' and of emphasizing that the problems addressed are not simply those of the developing countries but equally concern highly industrialized states. The observational requirements of ecology and pollution control, and the use of satellite and rocket systems is discussed. Attention is given to space stations, data processing, and data collection systems. F.R.L.

A72-31236 # Meteorological conditions favoring atmospheric pollution as detected via pictures received from satellites (Condizioni meteorologiche favorevoli all'inquinamento atmosferico rivelate con l'ausilio delle immagini ricevute dai satelliti). A. Fagioli (Aeronautica Militare, Servizio Meteorologico, Rome, Italy). In: Space activity in the field of ecology and earth resources; International Convention on Space, 12th, Rome, Italy, March 23-25, 1972, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1972, p. 173, 175-180. In Italian.

The ability of the atmosphere to disperse or dilute polluting materials depends on meteorological parameters, mainly air stability. By examining the pictures transmitted by meteorological satellites, it is possible to localize the stable air zones by observing the types of cloud coverage. The cloud types associated with stable air are discussed. European pictures of high-pressure atmospheric conditions are presented. B.B.M.

A72-31237 # Space studies of atmospheric pollution (Studi di inquinamento atmosferico dallo spazio). F. M. Vivona (CNR, Istituto di Fisica dell' Atmosfera, Rome, Italy). In: Space activity in the field of ecology and earth resources; International Convention on Space, 12th, Rome, Italy, March 23-25, 1972, Proceedings.

Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1972, p. 181, 183-190. 13 refs. In Italian.

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Description of space techniques for the study of atmospheric pollution, stressing infrared thermal radiation spectral measurements and laser soundings (including Raman spectroscopy). These techniques are shown to enable the mapping of the semistable volumes of polluted air associated with industrial areas and the correlation of the individual pollutants concentration and geographical distribution to the heat balance of a specific zone. Atmospheric pollution study via satellite photography is briefly considered. B.B.M.

A72-31252 # An application of remote sensing. R. C. Carnes (Bendix Corp., Aerospace Systems Div., Ann Arbor, Mich.). In: Space activity in the field of ecology and earth resources; International Convention on Space, 12th, Rome, Italy, March 23-25, 1972, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1972, p. 449, 451-463.

A recent airborne remote sensing mission flown by a U.S. aerospace corporation for the Water Resources Center at the University of Maine is discussed. A variety of instruments were carried and many different ecological target categories were surveyed. The equipment used included a Beech Queenaire aircraft, two thermal mappers, a reflectance spectrometer scanner, and a Hulcher P-70 tracking camera loaded with aerial panchromatic film. The mission described was flown from North to South down the Penobscot River. The objective of the mission was to examine the river for thermal, chemical, and solid pollutants and to map the contiguous terrain, particularly in the estuary. G.R.

A72-32623 # The remote sensing of oil spills by laser excited fluorescence. J. F. Fantasia, T. M. Hard, and H. C. Ingrao (U.S. Department of Transportation, Transportation Systems Center, Cambridge, Mass.). In: Environmental progress in science and education; Institute of Environmental Sciences, Annual Technical Meeting, 18th, New York, N.Y., May 1-4, 1972, Proceedings. Mount Prospect, Ill., Institute of Environmental Sciences, 1972, p. 342-356. 24 refs. Research sponsored by the U.S. Coast Guard.

An experimental measurement program was conducted to determine the feasibility of using laser-excited oil fluorescence as a means of detecting, identifying, and quantifying oil spills in the marine environment. Experiments with 29 crude and refined oils, commonly transported in the marine environment, show that: (1) oil films 0.2 micrometers thick are detectable; (2) each oil type has a distinct fluorescent spectral signature and when correlated with American Petroleum Institute (API) gravity, fluorescent conversion coefficient, and fluorescent lifetime, can be identified and classified; (3) the extent of the oil spill can be accurately measured; and (4) it appears oil film thicknesses, within certain limits, can be measured with this technique. Airborne detection, identification, and quantification of oil spills are shown to be feasible with existing equipment day or night. (Author)

A72-32624 * # Oil pollution signatures by remote sensing. C. E. Catoe (U.S. Coast Guard, Washington, D.C.) and J. T. McLean (NASA, Goddard Space Flight Center, Laboratory for Meteorology and Earth Sciences, Greenbelt, Md.). In: Environmental progress in science and education; Institute of Environmental Sciences, Annual Technical Meeting, 18th, New York, N.Y., May 1-4, 1972, Proceedings. Mount Prospect, Ill., Institute of Environmental Sciences, 1972, p. 357-367. 15 refs.

Study of the possibility of developing an effective remote sensing system for oil pollution monitoring which would be capable of detecting oil films on water, mapping the areal extent of oil slicks, measuring slick thickness, and identifying the oil types. In the spectral regions considered (ultraviolet, visible, infrared, microwave, and radar), the signatures were sufficiently unique when compared to the background so that it was possible to detect and map oil slicks. Both microwave and radar techniques are capable of operating in adverse weather. Fluorescence techniques show promise in identifying oil types. A multispectral system will be required to detect oil, map its distribution, estimate film thickness, and characterize the oil pollutant. F.R.L.

A72-39717 # Remote sensing of urban 'heat islands' from an environmental satellite. P. Krishna Rao (NOAA, National Environmental Satellite Service, Washington, D.C.). *American Meteorological Society, Bulletin*, vol. 53, July 1972, p. 647, 648. 15 refs.

ITOS-I satellite digitized IR data for Oct. 19, 1970, recorded over the United States east coast, are analyzed. The New York City and suburban area, Philadelphia, the industrial area between New York and Philadelphia, and the Baltimore and Washington areas are found to be warmer areas than the adjacent rural areas. V.Z.

A72-44263 Clouds and precipitation. J. D. Sartor (National Center for Atmospheric Research, Boulder, Colo.). *Physics Today*, vol. 25, Oct. 1972, p. 32-38. 17 refs.

It is pointed out that clouds and precipitation cleanse the atmosphere of natural and man-made pollutants or process them for later removal. The formation of clouds in the atmosphere is a consequence of the diffusion of water vapor onto suspended particles when moist air is cooled to slightly better than 100% saturation by adiabatic expansion. Studies of the physics of this process include theoretical calculations, measurements on laboratory models, and in situ measurements in clouds. Laboratory models have been improved with the design and construction of a 'particle control chamber' in which many of the relevant processes can be studied at will. Studies of mountain-wave clouds were conducted with the aid of a sailplane. G.R.

A72-44542 # Laser radar /lidar/ for mapping aerosol structure. R. J. Allen and W. E. Evans (Stanford Research Institute, Menlo Park, Calif.). *Review of Scientific Instruments*, vol. 43, Oct. 1972, p. 1422-1432. 9 refs. Contract No. CPA-70-49.

This paper describes a third-generation experimental Q-switched, ruby laser radar or lidar useful for air pollution mapping and meteorological studies. This system differs from its predecessors in that it incorporates (1) automatic inverse-range-squared receiver gain compensation, (2) coaxial transmitter and receiver optics, (3) automatic scanning and pulsing at equal angle increments or time intervals for fixed operation, and at equal distances traveled for mobile operation, and (4) video disk storage and instant replay of scan sequences. Details of these improvements are included. (Author)

A72-44639 # Application of differential OMEGA to remote environmental sensing. J. F. Kasper, Jr. (Analytic Sciences Corp., Reading, Mass.). *Institute of Navigation, Annual Meeting, 28th, U.S. Military Academy, West Point, N.Y., June 27-29, 1972, Paper*. 20 p. 13 refs.

A technique for obtaining enhanced Differential OMEGA performance is presented. It involves use of an information scheme based on the Kalman filter and requires knowledge of statistical properties of OMEGA phase errors and the environment being measured. Application of the technique to remote environmental sensing in the Arctic is suggested. Position and velocity accuracies of approximately 0.25 nm and 0.28 kts at widely scattered sites are obtained; these values represent potential improvement over conventional Differential OMEGA performance. (Author)

A72-45223 # Detection of waste water effluents and of their surface spread in the English channel, the North sea and the Baltic sea, through determination of the surface temperature of the sea by means of infrared air pictures taken by satellites (Erfassung der Abwasserzuflüsse und deren Flächenverteilung im Englischen Kanal, der Nord- und Ostsee durch Bestimmung der Oberflächentemperatur des Meeres mittels Infrarot-Satellitenluftbildern /IR-SLB/). H. Kaminski (Bochum, Sternwarte, Bochum, West Germany). *International Astronautical Federation, International Astronautical Congress, 23rd, Vienna, Austria, Oct. 8-15, 1972, Paper*. 122 p. 244 refs. In German.

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A73-11668 # Use of space techniques in the detection and monitoring of climate parameters and air pollutants (Die Anwendung von Weltraumtechniken auf die Erfassung und Überwachung von Klima-Parametern und luftverunreinigenden Stoffen). H.-J. Bolle (München, Universität, Munich, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 5th, Berlin, West Germany, Oct. 4-6, 1972, Paper 72-081*. 15 p. In German.

Important climate parameter measurements obtained with the aid of meteorological satellites and scheduled in current and future satellite programs are reviewed. Climate theory and models are discussed. Special attention is given to the role of clouds, particles, and trace gases in the planetary energy balance. M.V.E.

A73-13150 # Use of synchronous satellite for ecological survey. P. Biolkowicz (USAF, Institute of Technology, Wright-Patterson AFB, Ohio). *International Astronautical Federation, International Astronautical Congress, 23rd, Vienna, Austria, Oct. 8-15, 1972, Paper*. 48 p. 15 refs.

Problems involved in the application of a synchronous satellite in repetitive observations of a given spot on the earth's surface are discussed against a context of ecological surveys. Particular attention is given to the drift of small loops surrounding points of observations, which is caused by the oblateness of the earth and interferes with observations. An analysis of zonal, tesseral, and sectorial harmonics is considered as an approach to obtaining a self-sustaining satellite. Essential in this approach is the compensation of oblateness perturbations with perturbations caused by luni-solar attraction and solar pressure. It is found that at least a partial cancellation of the drift of the track can be achieved by this approach. V.Z.

A73-13845 Urban-change detection systems - Remote-sensing inputs. K. J. Dueker and F. E. Horton (Iowa, University, Iowa City, Iowa). *Photogrammetria*, vol. 28, Sept. 1972, p. 89-106. 11 refs.

The possibility of an application of remote-sensing technology to provide inputs to systems for urban-change detection is investigated. Urban-change detection refers to the recognition of changes in the urban system to provide important background material for urban planners, managers, and researchers. Such changes can be detected with the aid of conventional aerial photography and color-infrared imagery. The integration of remote-sensing data with conventionally collected data in a system that describes urban change is considered, giving attention to a conceptual framework for encoding spatial data. G.R.

A73-15129 # Orbiting laboratories and earth environmental survey. M. G. Markoff (Fribourg, University, Fribourg, Switzerland). In: *Colloquium on the Law of Outer Space, 14th, Brussels, Belgium, September 20-25, 1971, Proceedings*. South Hackensack, N.J., Fred B. Rothman and Co., 1972, p. 12-17. 39 refs.

Wide opportunities for earth survey are provided by a system using advanced operational satellites and a ground data handling system for acquiring, processing, and disseminating collected data to a variety of users. Information obtained from the small automatic orbiting laboratories, the ERT satellites, would be complemented by additional data acquired through low- and middle-altitude aircraft survey. The capabilities and willingness of the world community to cooperate in international space surveys on the human environment would certainly suffer if legal problems regarding state security, national sovereignty, and especially sovereignty in the matter of national natural resources are not solved in a generally satisfactory manner. F.R.L.

A73-15142 # Space programs and international environment protection. P. H. Sand (United Nations, Food and Agriculture Organization, Rome, Italy). In: *Colloquium on the Law of Outer Space, 14th, Brussels, Belgium, September 20-25, 1971, Proceedings*. South Hackensack, N.J., Fred B. Rothman and Co., 1972, p. 79-94. 90 refs.

Consideration of the environmental impact of space programs due to incidental or deliberate factors. An evaluation is made of the potential danger to the earth's environment due to side effects of space programs which are not part of the intended objectives of these programs. These effects include pollution from terrestrial sources such as hardware, rocket exhausts, and radiation and pollution resulting from the introduction of extraterrestrial matter into the earth's environment and from the combustion products of supersonic air transports in the stratosphere. An attempt is then made to assess the importance of deliberate interference with the earth's environment either through the use of hardware, chemicals, and radiation, through the introduction and commercial exploitation of extraterrestrial stock sources or by causing changes in solar radiation.

A.B.K.

A73-16767 The measurement of environmental pollution with the aid of aircraft and satellites (Messung der Umweltverschmutzung mittels Flugzeugen und Satelliten). H. G. Müller (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Physik der Atmosphäre, Oberpfaffenhofen, West Germany). (*Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 4th, Baden-Baden, West Germany, Oct. 11-13, 1971*.) In: *Deutsche Gesellschaft für Luft- und Raumfahrt, 1971 Yearbook*. Cologne, Deutsche Gesellschaft für Luft- und Raumfahrt, 1972, p. 292-305. 28 refs. In German.

Reliable approaches for the determination of the concentration of air pollutants provide the basis for the solution of the problems posed by the steadily increasing pollution of the atmosphere. An analysis is conducted concerning the pollution sources, the effective meteorological processes, the time scales involved, and the means for the measurement of air pollution. Light aircraft and small airships are most suitable for the surveillance of air pollutants on a local and regional level. Aircraft and satellites can both be used for the supervision of air quality in subcontinental areas. Satellites remain as the only effective means for dealing with the supervision of the environment on a global scale. G.R.

A73-17127 * Considerations and techniques for incorporating remotely sensed imagery into the land resource management process. W. G. Brooner and D. A. Nichols (California, University, Riverside, Calif.). In: *Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1*. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 1-24. 17 refs. Grant No. NGL-05-003-404.

Development of a scheme for utilizing remote sensing technology in an operational program for regional land use planning and land resource management program applications. The scheme utilizes remote sensing imagery as one of several potential inputs to derive desired and necessary data, and considers several alternative approaches to the expansion and/or reduction and analysis of data, using automated data handling techniques. Within this scheme is a five-stage program development which includes: (1) preliminary coordination, (2) interpretation and encoding, (3) creation of data base files, (4) data analysis and generation of desired products, and (5) applications. A.B.K.

A73-17132 * Remote sensing applications in urban and regional planning in the Los Angeles metropolis - Problems and accomplishments. D. R. Goehring (California, University, Riverside, Calif.) and J. S. McKnight (Regional Planning Commission, Los Angeles, Calif.). In: *Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1*. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 133-149, 151. 8 refs. Grant No. NGL-05-003-404.

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A73-17135 An application of a space technique for pollution detection. J. J. Hall (Boeing Co., Kennedy Space Center, Fla.). In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 254-273. 7 refs.

Description of the hazardous gas detection system (HGDS) used during Apollo-Saturn launch tests for identifying and analyzing extremely minute amounts of gases escaping during cryogenic loading. These gases included hydrogen, helium, nitrogen, oxygen, nitrogen tetroxide, and hydrazine N_2H_3 radical. The heart of the HGDS is a mass spectrometer operating under high vacuum and capable to measure both qualitatively and quantitatively the presence and percentage of any gas whose molecular weight is between 2 and 150 atomic mass units. It is suggested that such a system could be utilized to detect environmental pollutants. M.V.E.

A73-17138 Legal aspects of water pollution detection through remote sensing. F. M. Tuerkheimer. In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 302-314. 22 refs.

A73-18305 Global and local scale satellite surveillance of atmospheric pollution. A. McLellan (Wisconsin, University, Madison, Wis.). In: Annual Electro-Optical Systems Design Conference, 4th, New York, N.Y., September 12-14, 1972, Proceedings of the Technical Program. Chicago, Industrial and Scientific Conference Management, Inc., 1972, p. 244-249. 6 refs. U.S. Environmental Protection Agency Contract No. 68-02-002.

Satellite detection and monitoring capabilities are assessed with respect to various types of pollutants over both large global scales and small regions of local interest. It is shown that, in the future, with proper instrumentation on space platforms, it should be possible to identify by remote sensing the chemical composition of these pollutants. M.V.E.

A73-22326 Symposium on Air Pollution, Turbulence and Diffusion, Las Cruces, N. Mex., December 7-10, 1971, Proceedings. Edited by H. W. Church and R. E. Luna (Sandia Laboratories, Albuquerque, N. Mex.). Albuquerque, N. Mex., Sandia Laboratories, 1972. 398 p. \$6.00.

The subjects discussed are related to air resources management, instrumentation and remote sensing, the theory of turbulence and the boundary layer, and climatic effects. Diffusion prediction methods are considered, giving attention to the identification of aerosols in the southwestern U.S., diffusion from an instantaneous line source in the atmospheric surface layer, the Wiener-Hermite expansion applied to passive scalar dispersion in a nonuniform turbulent flow, and the computational evaluation of the Gaussian plume model.

G.R.

A73-25399 Emission and immission measurements of air pollution with the aid of lasers (Emissions- und Immissionsmessungen von Luftverunreinigungen mittels Laser). R. Beck and W. Englisch (Battelle-Institut, Frankfurt am Main, West Germany). (Fachtagung über Umweltverschmutzung, Mess- und Kontrolleinrichtungen, Frankfurt am Main, West Germany, Mar. 21-24, 1972.) Messtechnik, Feb. 1973, p. 39-45. In German.

The use of a laser permits gaseous air pollutants to be analyzed fast and accurately even at low concentrations. Not only single

samples or continuous streams for air but also remote clouds of pollutants can be analyzed in this way. Basically, there are three different methods of remote analysis. They are based on Raman scattering, resonance fluorescence or resonance absorption measurements. The best results may be obtained by the resonance absorption method. (Author)

A73-29196 * Detection of oil spills using a 13.3-GHz radar scatterometer. K. Krishen (Lockheed Electronics Co., Inc., Earth Observations Dept., Houston, Tex.). *Journal of Geophysical Research*, vol. 78, Apr. 20, 1973, p. 1952-1963. 12 refs. Contract No. NAS9-12200.

This paper describes the results of an analysis of 13.3-GHz single-polarized scatterometer data collected during NASA/MSC mission 135, flown on March 16, 1970. Data were gathered over a crude oil spill on the Gulf of Mexico (test site 128) off the Mississippi delta. With the aid of RC-8 camera photographs the scattering cross section was correlated with the extent of the oil spill. The scattering cross section at higher incidence angles (25 to 60 deg) decreased by 5-10 db in the presence of the oil spill. This was attributed to the damping by oil of small gravity and capillary waves. The composite scattering theory and the scatterometer-acquired data were used to obtain an expression of radar scattering over ocean surfaces with oil spills. The study demonstrates that the presence and extent of oil spills can be detected with high-frequency radar systems. (Author)

A73-29300 # Land-use products for Mississippi. I. G. W. North (U.S. Geological Survey, Bay St. Louis, Miss.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 9th, Washington, D.C., Jan. 8-10, 1973, Paper 73-3*. 8 p. 8 refs. Members, \$1.50; nonmembers, \$2.00.

Questions of land use terminology are discussed together with a land-use classification system, giving attention to land users, the information needed, details regarding land-use maps, the type of data bank to be established, and requirements concerning the development of an effective national/state land-use program. Aspects of the Mississippi land-use program are considered together with a procedure for the use of small scale photography and land-use classification. G.R.

A73-33352 The present and future environmental satellite system. C. A. Spohn (NOAA, National Environmental Satellite Service, Suitland, Md.). In: Operational remote sensing; Proceedings of the Seminar, Houston, Tex., February 1-4, 1972. Falls Church, Va., American Society of Photogrammetry, 1972, p. 21-27; Discussion, p. 28.

The basic spacecraft of the present system is the Improved Tiros Operational Satellite (I-TOS). It is earth-oriented and rectangular, with a spinning wheel for stability control, and is powered by solar panels. The present I-TOS spacecrafts carry a complement of eight sensors. The primary sensors include the Advanced Vidicon Camera System, the Automatic Picture Transmission Camera, and the Scanning Radiometer. The secondary sensors are the Solar Proton Monitor and the Flat Plate radiometer. The future I-TOS D spacecraft for low near-polar orbiting satellites will begin to meet the first objectives in the environmental, nonmeteorological field. F.R.L.

A73-33360 Quantitative thermal mapping problems. C. O. Thomas and F. M. Shofner (Environmental Systems Corp., Knoxville, Tenn.). In: Operational remote sensing; Proceedings of the Seminar, Houston, Tex., February 1-4, 1972. Falls Church, Va., American Society of Photogrammetry, 1972, p. 141-144; Discussion, p. 145.

Major attention is given toward thermal mapping applications at electrical power generating sites, i.e., the mapping of the thermal outfall from fossil or nuclear fuel plants. The material is stated from the viewpoint of the client, rather than the equipment manufacturer or survey firm. This is considered to be the application area with the greatest present need for quantitative thermal information, and the

application with the greatest technical potential for airborne thermal mapping. Complete thermal analysis requires three-dimensional data. The data-tape route is believed to be superior to the direct record route for quantitative or even qualitative operations and, even with data tape methods, the eventual film imagery should not be viewed as the 'quantitative' record.

F.R.L.

A73-33363 Utility of remote-sensing data for urban land use planning. K. J. Dueker and F. E. Horton (Iowa, University, Iowa City, Iowa). In: Operational remote sensing; Proceedings of the Seminar, Houston, Tex., February 1-4, 1972. Falls Church, Va., American Society of Photogrammetry, 1972, p. 178-190.

The utility of land-use data of remote sensors for a medium-size metropolitan planning agency is discussed. Census tract summaries of land-use information from assessor's parcel data are compared with data collected by interpreting various scale photographic imagery. Small area populations are estimated by using variables extracted from remote-sensing imagery.

V.Z.

A73-33364 Applications of high-altitude remote sensing to coastal zone ecological studies. R. R. Anderson (American University, Washington, D.C.). In: Operational remote sensing; Proceedings of the Seminar, Houston, Tex., February 1-4, 1972.

Falls Church, Va., American Society of Photogrammetry, 1972, p. 191-195.

Data derived from high-altitude small-scale imagery are discussed in application to wetland mapping projects, noting their significant potential for contribution to a program for coastal zone management. The subjects include wetland evaluation and monitoring, water salinity assessment, power plant siting projections, shoreline current monitoring and erosion control.

V.Z.

A73-33402 * Instrumentation for air quality measurements. M. Loewenstein (NASA, Ames Research Center, Moffett Field, Calif.). *IEEE Transactions on Aerospace and Electronic Systems*, vol. AES-9, Jan. 1973, p. 11-17. 11 refs.

Comparison of the new generation of air quality monitoring instruments with some more traditional methods. The first generation of air quality measurement instruments, based on the use of oxidant coulometric cells, nitrogen oxide colorimetry, carbon monoxide infrared analyzers, and other types of detectors, is compared with new techniques now coming into wide use in the air monitoring field and involving the use of chemiluminescent reactions, optical absorption detectors, a refinement of the carbon monoxide infrared analyzer, electrochemical cells based on solid electrolytes, and laser detectors.

A.B.K.

A73-33552 * # Correlation interferometric measurement of trace species in the atmosphere. H. W. Goldstein, M. H. Bortner, R. N. Grenda, A. M. Karger (GE Space Sciences Laboratory, Philadelphia, Pa.), and P. J. LeBel (NASA, Langley Research Center, Hampton, Va.). *American Institute of Aeronautics and Astronautics and American Meteorological Society, International Conference on the Environmental Impact of Aerospace Operations in the High Atmosphere*, Denver, Colo., June 11-13, 1973, AIAA Paper 73-515. 11 p. 8 refs. Members, \$1.50; nonmembers, \$2.00. Contract No. NAS1-10139.

Two correlation interferometers, a breadboard model and an engineering model, have been designed, constructed, and tested for the measurement of selected atmospheric trace species. Test results showed that errors of less than 10% are attainable for atmospheric amounts of carbon monoxide and methane measured at 2.3 microns. Based on these results a program has been undertaken to determine the feasibility of measuring other trace species by correlation interferometry. It is shown that in addition to carbon monoxide and methane, carbon dioxide, water vapor, ammonia, nitric oxide, nitrous oxide, nitrogen dioxide, and sulfur dioxide can also be accurately measured with this instrument.

(Author)

A73-34552 Detection of nitric oxide in the stratosphere (Détection de l'oxyde azotique dans la stratosphère). A. Girard, J.-C. Fontanella, and L. Gramont (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *Académie des Sciences (Paris), Comptes Rendus, Série B - Sciences Physiques*, vol. 276, no. 22, May 28, 1973, p. 845, 846. In French.

Observation of absorption lines characteristic of nitric oxide during the course of an airborne experiment carried out on April 5, 1973, at an altitude of 11.8 km. The presence of nitric oxide in the stratosphere was detected with the aid of an infrared grating spectrometer on board a Caravelle aircraft. The absorption spectrum, obtained by pointing at the sun in a horizontal direction, shows five lines characteristic of the nitric oxide molecule between 1901 and 1910 per cm (5.26 to 5.23 microns), the intensities of which made it possible to evaluate the concentration as being (7 plus or minus 3) x 10 to the minus 10th power.

A.B.K.

A73-34926 The control of the terrestrial environment from space: International collaboration, methods and technologies; International Conference on Space, 13th, Rome, Italy, March 22-24, 1973, Proceedings (Il controllo dell'ambiente terrestre dallo spazio: Collaborazioni internazionali, metodi e tecnologie; Convegno Internazionale sullo Spazio, 13th, Rome, Italy, March 22-24, 1973, Atti). Conference sponsored by the Ministero degli Affari Esteri and Associazione Industrie Aerospaziali. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1973. 413 p. In Italian, English, and French.

Topics discussed include the Global Atmospheric Research Program, the monitoring of climate parameters with the aid of satellites, the use of remote sensing for the detection of natural resources, temperature sounding of the atmosphere with the aid of the Nimbus 3 satellite, the evaluation of vertical temperature and geopotential profiles from satellite pictures, infrared sensing of the surface temperature of lakes, remote sensing of hydrology and aquatic biology by aircraft and satellites, the effect of structural elasticity and flexible appendages on attitude control of a satellite, the use of rockets for earth environment soundings, remote sensing of the sea surface by satellites, and the potential of passive microwave radiometry in earth resource surveys.

A.B.K.

A73-34928 # Prospects and requirements to monitor climate parameters with the aid of space techniques. H.-J. Bolle (München, Universität, Munich, West Germany). In: The control of the terrestrial environment from space: International collaboration, methods and technologies; International Conference on Space, 13th, Rome, Italy, March 22-24, 1973, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1973, p. 45, 47-55. 10 refs.

Consideration of the use of satellites to monitor the parameters which determine climate. A brief survey is made of some basic climatic problems, including the problem of the energy transport from lower to higher latitudes and the problem of regional dynamical processes initiated by an energetic imbalance. The functional relationships used in various types of climatic models are summarized. It is shown that five types of parameters have to be monitored for climate studies. The prospects of monitoring these parameters from space are considered, dwelling, in particular, on the problem of how the applied techniques can systematically be improved and supplemented in order to obtain a complete picture of the behavior of these parameters.

A.B.K.

A73-34931 # Environmental monitoring from space for European demands. J. Bodechtel (Zentralstelle für Geo-Photogrammetrie und Fernerkundung, Munich, West Germany). In: The control of the terrestrial environment from space: International collaboration, methods and technologies; International Conference on Space, 13th, Rome, Italy, March 22-24, 1973, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1973, p. 101, 103-112.

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Consideration of the use of satellites to monitor the earth's environment and natural resources. The major advantages of earth observation from space are reviewed, and the available high-resolution systems for multispectral sensing are cited. Tables are presented which show the typical requirements for remote monitoring of environmental phenomena for European needs. The inadequacy of the ERTS-1 satellite for satisfying European demands is noted, in particular, the relatively low repetition rate of this satellite and the lack of nearly real-time data due to the absence of a receiving station in Europe. A.B.K.

A73-35806 Oil spills - Measurements of their distributions and volumes by multifrequency microwave radiometry. J. P. Hollinger and R. A. Mennella (U.S. Navy, E. O. Hulburt Center for Space Research, Washington, D.C.). *Science*, vol. 181, July 6, 1973, p. 54-56. 12 refs. U.S. Coast Guard Contract No. Z-70099-2-21881.

A73-36020 * # Remote sensing techniques for support of coastal zone resource management. R. O. Piland (NASA, Johnson Space Center, Earth Resources Laboratory, Houston, Tex.). *COSPAR, Plenary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper*. 25 p. 6 refs.

Description of remote sensing studies carried out for the purpose of developing and/or demonstrating techniques which can be employed for land use inventory, marsh vegetation classification, and water characteristics surveys. Attention is given to results obtained with (1) photo interpretation techniques and procedures for the development of land use information from high-altitude aircraft and satellite imagery, (2) computer based pattern recognition techniques utilizing multispectral scanner data for marsh vegetation classification, and (3) infrared and microwave techniques for the monitoring and surveying of coastal water temperature and salinity characteristics. T.M.

A73-36252 * # Theoretical analysis of improvements in remote sensing of atmospheric and pollutant gases through high resolution detection of individual infrared emission lines. R. K. Seals, Jr. (NASA, Langley Research Center, Environmental and Space Sciences Div., Hampton, Va.). *American Institute of Aeronautics and Astronautics, Fluid and Plasma Dynamics Conference, 6th, Palm Springs, Calif., July 16-18, 1973, Paper 73-703*. 9 p. 12 refs. Members, \$1.50; nonmembers, \$2.00.

A73-38266 Contributions of the DFVLR to environmental research and environment protection. II - Noise control, water environment protection, nature and landscape, environmental protection techniques (Beiträge der DFVLR zur Umweltforschung und zum Umweltschutz. II - Lärmbekämpfung, Gewässerschutz, Natur und Landschaft, umweltfreundliche Technik). D. Paffrath (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Physik der Atmosphäre, Oberpfaffenhofen, West Germany). *DFVLR-Nachrichten*, July 1973, p. 417-421. In German.

Recent studies of the generation and propagation of jet aircraft noise and sonic boom are reviewed, and noise-measurement and noise-reduction methods are discussed. The considerations include technological noise-reduction techniques, the selection of favorable flight paths, and proper airport planning and design. The application of remote sensing from aircraft and satellites to the study of the conditions on the earth's surface is examined, and the contribution of these techniques to the protection of lakes and rivers from pollution is outlined. Developments in MHD propulsion, ion engines, and other nonpolluting propulsion systems are discussed. V.P.

A73-38583 * # Environmental monitoring via the ERTS-1 Data Collection System. J. E. Painter (NASA, Goddard Space Flight Center, Greenbelt, Md.) and J. E. Seitzer (GE Valley Forge Space Center, Valley Forge, Pa.). *American Astronautical Society, Annual Meeting, 19th, Dallas, Tex., June 19-21, 1973, Paper 73-122*. 17 p.

The Data Collection System (DCS) provides users with near real-time environmental data from earth-based sensors relayed via the Earth Resources Technology Satellite (ERTS-1) to Goddard Space Flight Center. Data is received at Goddard at least twice per day from each sensor and distributed to users (who operate the sensors and transmitters) by mail and teletype. Data collection platforms are discussed together with DCS equipment and the ground receiving and processing equipment. G.R.

A73-39829 * International Symposium on Remote Sensing of Environment, 8th, University of Michigan, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volumes 1 & 2. Symposium sponsored by the Environmental Research Institute of Michigan, University of Michigan, NASA, et al. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973. Vol. 1, 825 p.; vol. 2, 780 p. Price of two volumes, \$35.

Recent developments in remote sensing techniques and applications are described in papers dealing with (1) ground-based, airborne, and space-borne sensor systems, (2) machine assisted data analysis and interpretation, and (3) specific uses of sensing techniques by various government units. Topics covered include monitoring of environmental quality factors, delineation of geological formations and mineral deposits, watershed management, observation of vegetative parameters in forestry and agriculture, design and performance details of various sensor systems and equipment, interpretation of multispectral imagery, and applications of ERTS-1 satellite imagery in resource study programs. T.M.

A73-39830 # Development of a practical remote sensing water quality monitoring system. J. P. Scherz (Wisconsin, University, Madison, Wis.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 35-45. 7 refs.

The focus of the research was to answer questions of what parameters show up on images of water quality, how such parameters can be effectively measured from the image, and to determine what combination of hardware will provide an economical, workable monitoring system for practical application. Work on this research was devoted primarily to photography and thermal scanning. Thermal scanning has proven to be a most practical working tool for monitoring thermal discharges into water. The level of municipal and industrial pollution, however, seems most practically and best monitored by photography. The effects caused by the water surface, angle of incidence and illumination, and bottom effects are discussed. F.R.L.

A73-39831 * # Users report for the Northern Great Plains. I. A. Waltz, V. I. Myers, and L. R. Heinemann (South Dakota State University, Brookings, S. Dak.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 47-52. 5 refs. U.S. Geological Survey Contracts No. 14-08-0001-12510; No. 14-08-0001-12862; Grant No. NGL-42-003-007.

The applications of remote-sensing techniques offer new approaches to many of the present-day problems encountered by various state agencies in South Dakota. The study was completed in three phases. The first report presented the information needs of the state agencies and educational efforts; the second defined the data handling procedures for fulfilling the applications; and the third phase was a development of a dynamic information dissemination plan on a state-wide basis. Aircraft data, satellite imagery, and other remotely sensed information are valuable for decision-making processes. A design for an organization to acquire for the state the advantages of remote-sensing systems for resources research and management has been developed. F.R.

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A73-39832 * # Regional land inventory systems development in the Houston area. J. E. Dornbach (NASA, Johnson Space Center, Houston, Tex.) and J. B. Harris. In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 53-60.

A73-39833 # Remote sensing applications in the Metropolitan Washington Council of Governments. H. J. Mallon. In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 61-97. 18 refs.

A major research project is being conducted to determine if remote sensing imagery and associated data from high-altitude aircraft can be used to monitor land development patterns, housing and neighborhood differences, changes in air and water pollution, and other aspects of local and regional life. The results obtained so far have shown that regional planning data needs of many kinds can be met from remote sensing analysis functioning in close association with staff planning elements. G.R.

A73-39834 # An integrated resource survey using orbital imagery - An example from south-east Spain. J. L. van Genderen (Sheffield, University, Sheffield, England). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 117-136. 26 refs. Research supported by the Royal Geographical Society and University of Sheffield.

An investigation is being carried out on the methodology of integrated surveys of natural resources using orbital imagery in the Murcia province, Spain. The Mula test site has been mapped and classified into 200 'land units.' These units are characterized by a narrow range of variation in landform, soil, and vegetation. The recurrence of a number of units within a land system in a regular pattern gives rise to the distinctive recurring tonal pattern on the aerial photographs. The recognition of these patterns is an integral part of the reconnaissance survey carried out. The aspects considered are related to orbital image interpretation of integrated resource surveys at a regional reconnaissance level. G.R.

A73-39845 # Urban land use from RB-57 photography - Computer graphics of the Boston area. R. B. Simpson, D. T. Lindgren (Dartmouth College, Hanover, N.H.), and R. S. Yuill (Central Michigan University, Mt. Pleasant, Mich.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 299-309.

A73-39846 * # Remote sensing in the detection of regional change. J. E. Estes and L. W. Senger (California, University, Santa Barbara, Calif.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 317-324. Grant No. NGL-05-003-404.

Investigation of the impact of the California State Water Project on the west side of the San Joaquin Valley, using aerial photo mosaics and high-altitude photography for 1957 and 1971. Particular attention is paid to a determination of gross land use change and to the detection of specific patterns of development emerging from this change. Information derived from the mapping and tabulating of data acquired in this study indicates a definite trend toward the development of an agricultural landscape and increasing intensification of land use on the west side of the San Joaquin Valley. The introduction of water into this arid region is resulting in large acreages of land being brought under cultivation. Consequently, cropland is assuming a more dominant position with respect to areal extent. A.B.K.

A73-39847 # The use of small-scale multi-band photography for detecting land-use change. H. F. Lins, Jr. and V. A. Milazzo (U.S. Geological Survey, Washington, D.C.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 325-343. 12 refs.

Recent small-scale photography from two separate high-altitude NASA aircraft missions was used to map land use and detect land use change for both an urban and rural study area. Photographic frames in three spectral bands from each mission were combined on the IIS additive color viewer from which land use for both time periods was mapped using a high altitude compatible land use classification scheme. Resultant land use and land use change maps were produced which indicated that authentic changes in land use could be detected. In addition, the change maps showed strikingly a number of apparent land use changes at points where, in reality, no change occurred. The detection of these 'false change areas' can be attributed, in part, to inherent inconsistencies that arise when analyzing photography from two separate systems on a comparative basis. These inconsistencies also illustrate the need for control in the photo processing stage. (Author)

A73-39848 * # NASA environmental applications demonstrations in southeastern United States. C. T. N. Paludan (NASA, Marshall Space Flight Center, Huntsville, Ala.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 345-350. 12 refs.

A73-39850 * # Utilizing remote sensing data for land use decisions for Indian lands in South Dakota. C. J. Frazee, F. C. Westin (South Dakota State University, Brookings, S. Dak.), and R. L. Carey (U.S. Department of the Interior, Bureau of Indian Affairs, Aberdeen, S. Dak.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 375-391. 10 refs. U.S. Department of the Interior Contract No. A00C14201232; Grant No. NGL-42-003-007.

Evaluation of photographic and thermal infrared imagery acquired at an altitude of 11,500 ft above ground level (in southwestern South Dakota) on Oct. 15, 1970, June 30, 1971, and Aug. 2, 1971, for use in mapping range sites and soils. A density slicing system was used to enhance film optical density differences associated with range sites and soils. The range site boundaries in native rangeland areas were found to be delineated best by a density slicing analysis of color infrared film obtained in August 1971. The range site maps produced by density slicing were superior to existing range inventory maps. The density slicing analysis of color infrared film from the August 1971 flight was best for locating soil boundaries in rangeland areas. To adequately map soils in rangeland areas, data based on density slicing used in conjunction with slope gradient information derived from stereoscopic analyses provided more detailed and accurate information than is presently available from range site and soil maps of the area. A.B.K.

A73-39851 * # A comprehensive remote sensing legend system for the ecological characterization and annotation of natural and altered landscapes. C. E. Poulton (Oregon State University, Corvallis, Ore.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 393-408. 30 refs. Research supported by the Oregon State Land Board, U.S. Department of the Interior, and NASA.

A73-39854 # Structure of dust storms from ITOS-I T.V. images obtained over Iraq and the Gulf of Persia. B. V. Vinogradov (Moscow Institute of Aerospace Methods, Moscow, USSR), A. A.

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Grigor'ev, and V. B. Lipatov (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 463-466. 5 refs.

A73-39861 # Eutrophication assessment using remote sensing techniques. C. T. Wezernak and F. C. Polcyn (Michigan, Environmental Research Institute, Ann Arbor, Mich.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1.

Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 541-551. 18 refs. U.S. Environmental Protection Agency Contracts No. 16020-FOY; No. R-800778.

A73-39862 # Multispectral survey of power plant thermal effluents in Lake Michigan. F. C. Polcyn, W. L. Brown, and S. R. Stewart (Michigan, Environmental Research Institute, Ann Arbor, Mich.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 583-601.

Results of a study of selected thermal effluents discharged into Lake Michigan during the period from April to May 1971, using an airborne multispectral scanner to observe the thermal discharges. A direct relationship is found to exist between the critical area of the plume, the power load on the plant, and the wind velocity. In addition, some findings regarding the interaction between the thermal bar and a warm water discharge plume are presented which were obtained by a process in which water masses of the same spectral characteristics are enhanced and then displayed by an arbitrary color code. It is concluded that the results of the multispectral surveys demonstrate the usefulness of new technology to map large areas repetitively in short times to produce quantitative thermal measurements and to measure their areal extent. A.B.K.

A73-39866 # Applications of remote sensing in public health. C. M. Barnes, C. E. Fuller, H. J. Schneider, E. E. Kennedy (NASA, Johnson Space Center, Health Services Div., Houston, Tex.), H. G. Jones (Boeing Co., Houston, Tex.), and D. R. Morrison. In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 677-684.

Current research concerning the determination of the habitat of mosquito vectors of disease is discussed. It is shown how advanced interpretative processes have enabled recognition of the breeding areas of salt marsh mosquitoes and the breeding sites of the mosquito responsible for the transmission of St. Louis strain of encephalitis and of human filariasis. In addition, remote sensing data have also been useful in the study of the habitat of endemic strains of Venezuelan encephalitis virus in Florida. The beginning of the application of remote sensing to such public health aspects as air, water, and urban degradation is noted. V.P.

A73-39867 # Water quality determinations in the Virgin Islands from ERTS-A data. W. G. Egan (Grumman Aerospace Corp., Bethpage, N.Y.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 685-708. 9 refs. Research supported by the Grumman Aerospace Corp. and NASA.

The characterization of water quality in terms of absolute color values, using imagery from the ERTS-A satellite, imagery from aircraft, and ground truth measurements is discussed. The establishment of photometric standards resolvable by the ERTS-A sensors, as a means of determining atmospheric effects (which generally vary on sequential overpasses) is examined. The application of these tech-

niques is demonstrated for the harbor of Charlotte Amalie on St. Thomas, Virgin Islands, which is characterized by the presence of many polluting factors. V.P.

A73-39892 # Detection of oil spills using a 13.3-GHz radar scatterometer. K. Krishen (Lockheed Electronics Co., Inc., Earth Observations Dept., Houston, Tex.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 1105-1119. 12 refs.

This paper describes the results of an analysis of 13.3-GHz single polarized scatterometer data collected during NASA/MSC Mission 135, flown on March 16, 1970. Data were gathered over a crude oil spill on the Gulf of Mexico off the Mississippi Delta. With the aid of RC-8 camera photographs, the scattering cross section was correlated with the extent of the oil spill. The scattering cross section at higher incidence angles (25 to 50 deg) decreased by 5 to 10 dB in the presence of the oil spill. This was attributed to the oil's damping of small gravity and capillary waves. The composite scattering theory and the scatterometer-acquired data were used to obtain an expression of radar scattering over ocean surfaces with oil spills.

(Author)

A73-39908 # Monitoring levels of existing environmental impact utilizing remote sensing techniques. M. M. McCarthy (Wisconsin, University, Madison, Wis.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 1385-1409. 24 refs.

Remote sensing can be an effective technique for measuring environmental impact. Quantification of the spatial extent of impact for a given unit of land provides meaningful information for land use decision makers. Although the study is restricted to a specific region, the basic concept - the use of biological indicators that can be monitored through remote sensing for evaluation of levels of existing environmental impact - has universal application. Certain types of environmental impact illustrate no gradient of change, but these impacts often completely alter the abiotic and biotic community. The concept of impact is not generally polarized to the extremes. In any area a variety of conditions exists in a continuum between the end points of total destruction and total lack of involvement by man. It is this gradient of change that must be understood for every area under study. (Author)

A73-39910 # Interdisciplinary research on the application of ERTS-1 data to the regional land use planning process. J. L. Clapp, R. W. Kiefer, M. M. McCarthy, and B. J. Niemann, Jr. (Wisconsin, University, Madison, Wis.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 1429-1463. Contract No. NAS5-21754.

Although the degree to which ERTS-1 imagery can satisfy regional land use planning data needs is not yet known, it appears to offer means by which the data acquisition process can be immeasurably improved. This paper documents the initial experiences of an interdisciplinary group attempting to formulate ways of analyzing the effectiveness of ERTS-1 imagery as a base for environmental monitoring and the resolution of regional land allocation problems. Because of the need to describe and depict regional resource complexity in an interrelatable state, certain resources within the geographical regions have been inventoried and stored in a two-dimensional computer-based map form. Computer oriented processes were developed to provide for the economical storage, analysis and spatial display of natural and cultural data for regional land use planning purposes. Statistical programs have been developed that correlate interpreted data with stored data, both spatially and numerically. (Author)

A73-40816 # Earth surveys by remote sensing in Israel. J. Otterman and A. Ginzburg (Tel Aviv University, Tel Aviv, Israel). *COSPAR, Plenary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper. 10 p. 11 refs.*

Description of recent earth-surveying activities in Israel by the new techniques of remote sensing, spanning the period from 1970 to 1973. Highland-based and airborne surveys implementing thermal infrared mapping of the Lake Kinneret saline springs in 1970 and of the Mediterranean Sea in 1971 have been followed by the still ongoing multidisciplinary research program based on analyses of the image material from the ERTS-1 satellite. This program includes the mapping of agricultural crops and natural vegetation, as well as studies of arid regions, hydrology, geology, and oceanography. The preliminary results obtained include the discovery of a seasonal giant eddy in the Bay of Suez. M.V.E.

A73-41520 * # ERTS-1 - Toward global monitoring. J. C. Fletcher (NASA, Washington, D.C.). *Astronautics and Aeronautics*, vol. 11, Sept. 1973, p. 32-35.

The satellite has a near-polar orbit with a mean altitude of about 547 n. mi. On the average six million square kilometers are mapped daily. The multispectral scanner and other essential systems on board the satellite have suffered no detectable degradation since the early failures of a circuit switch and one of the two tape recorders. A year of ERTS-1 experience has shown that many applications can be mechanized with the present instrumentation. New investigations planned for future satellites are discussed, giving attention to pollution monitoring, geological studies, heat-balance surveys, and the analysis of damage caused by storms and earthquakes. G.R.

A73-43225 * Polarization - A key to an airborne optical system for the detection of oil on water. J. P. Millard and J. C. Arvesen (NASA, Ames Research Center, Space Sciences Div., Moffett Field, Calif.). *Science*, vol. 180, June 15, 1973, p. 1170, 1171.

Skylight polarization, which varies with the position of the sun in the sky, influences the contrast of oil on water. Good contrast is most consistently obtained by viewing in azimuth directions toward or away from the sun. Contrast is enhanced by imaging selected polarization components and by taking the difference between orthogonal polarization components. (Author)

A73-43605 The surveillant science: Remote sensing of the environment. Edited by R. K. Holz (Texas, University, Austin, Tex.). Boston, Houghton Mifflin Co., 1973. 401 p. \$7.95.

The electromagnetic spectrum is discussed together with questions concerning the capabilities and limitations of remote sensors, remote sensing techniques for mineral discovery, approaches for the remote sensing of luminescent materials, and problems of UV imaging. The employment of conventional photography is considered, giving attention to photographic interpretation, the types of aerial photographs, applications of color aerial photography to water resources studies, a large-scale photo assessment of smog-damaged pines, and aspects of space photography. Developments regarding the remote sensing in the reflected or near IR are reported together with aspects of remote sensing in the thermal or emitted IR, passive-microwave imaging, radar applications, multispectral remote sensing, and the social implications of remote sensing. G.R.

A73-43780 Use of space techniques for the determination and monitoring of climate parameters and air contaminants (Die Anwendung von Weltraumtechniken auf die Erfassung und Überwachung von Klima-Parametern und luftverunreinigenden Stoffen). H.-J. Bolla (München, Universität, Munich, West Germany). *Raumfahrtforschung*, vol. 17, July-Aug. 1973, p. 169-175. 32 refs. In German.

Climate is primarily determined by the radiation balance, which can be disturbed by man's activity. Possible changes of climate can be studied by means of mathematical climatological models. The necessary input data have to be sampled over the whole earth for a long period. Satellites can advantageously be used to gather data

about some of the most important parameters such as (1) the planetary radiation budget and its variations in space and time, (2) clouds, (3) particles, and (4) trace gases. The experimental methods already in use or to be developed for this task are briefly discussed. (Author)

N70-17236# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.

VARIATIONS IN THE ABSORPTION SPECTRA OF ATMOSPHERIC DUST

G. B. Hoidale, A. J. Blanco, N. L. Johnson, and R. V. Doorey Oct. 1969 36 p refs

(AD-697108; ECOM-5274) Avail: CFSTI CSCL 4/2

Six impactor and 99 membrane filter samples of atmospheric dust were collected atop a mountain in south central New Mexico during April and May 1968. Qualitative analysis of these samples by infrared absorption spectroscopy in the 4000 to 250/cm wavenumber (2.5 to 40 micron wavelength) range revealed that the positions and relative intensities of the absorption bands were dependent on the size fraction of the dust and on the time the sample was taken. Within the 1250 to 770/cm (8 to 13 micron) atmospheric window, the micron-sized (giant) particles exhibited a peak absorption at 1027/cm (9.7 micron), whereas the submicron (large) particles had their peak absorption at 1108/cm (9.0 micron). These two absorption bands are induced, respectively, by silicate clays and by ammonium sulfate. A temporal variation was observed in the ratio of the intensities of the 1027/cm (9.7 micron) silicate and the 1425/cm (7.0 micron) carbonate absorption bands of the giant particles. This ratio was high during the early morning, at times of convective activity and precipitation and at times of cold frontal passage from the east; it was low during the afternoon and at times of convective inactivity and no precipitation. The low ratio dust is attributed to advection of fresh soil particles from the exchange layer over the adjacent basin and mountains and the high ratio dust to advection of fresh soil particles from the Great Plains and aged soil particles from the overlying free atmosphere. Author (TAB)

N70-27235# Argonne National Lab., Ill. Dept. of Air Pollution Control.

AN URBAN ATMOSPHERIC DISPERSION MODEL

J. J. Roberts, E. J. Croke and A. S. Kennedy Oct. 1969 116 p refs

(Contract w-31-109-eng-38)

(ANL/ES-CC-5) Avail: CFSTI

A multiple source, computerized atmospheric dispersion model designed for operational use in air resource management has been formulated and programmed for the IBM 360-75 system. The development and preliminary validation testing of the model is described against data from a three-year, computerized inventory of sulfur dioxide air quality data recorded by the receptors of the Chicago, Illinois, telemetered air monitoring system. A detailed, two-year inventory of Chicago coal and oil burning SO₂ emission sources was acquired, data storage formats were designed, and computer algorithms were developed to generate hourly average estimates of emission from major utility, industrial, residential, commercial, and institutional sources. Small emitters were aggregated into square mile area sources. Hourly time series plots of observed and actual SO₂ concentrations indicate that the model is sufficiently accurate to test selective hypotheses about the model itself and to evaluate urban air resource management strategies. Author

N70-36219# Aerojet-General Corp., El Monte, Calif. Geosciences Group.

RADIOMETRIC DETECTION OF OIL SLICKS Final Report, 14 Mar.-26 Oct. 1969

A. T. Edgerton and D. T. Trexler Jan. 1970 130 p refs

(Contract DOT-CG-93228-A)

(AD-702402; AGC-SD-1335-1) Avail: CFSTI CSCL 13/2

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A study has been performed to assess the feasibility of using microwave radiometry for detection of oil pollution. The investigation stems from the U.S. Coast Guards requirement for an airborne surveillance system which can detect oil pollution during inclement weather and during the hours of darkness. Laboratory and airborne measurements were made of a variety of oil base pollutants. Laboratory investigations included microwave response as a function of oil film thickness, physical temperature of the oil-water system, pollutant type sensor wavelength, antenna polarization, and observation angle. These studies consisted of dual-polarization radiometric measurements (observational wavelengths of 0.8cm and 2.2cm) of Bunker C fuel oil, gasoline, and 20, 30, and 40 API gravity crude oil. The dielectric properties of these pollutants were also measured by means of a 0.81 cm ellipsometer. The results of the laboratory measurements were used to select the most suitable microwave radiometer for the airborne measurements. The airborne measurements were of small oil slicks on the open ocean off the Southern California Coast. Measurements were made from an aircraft instrumented with a dual-polarized 0.81 cm radiometer oriented with a forward antenna viewing angle of 45 deg from nadir. Pollutants examined during the tests include marine diesel fuel; 20, 30, and 40 API gravity crude oils; and a mixture of diesel fuel and 20-gravity oil. Measurements were made under various atmospheric and low sea state conditions, including several at night.

Author (TAB)

N71-11993*# Barringer Research, Ltd., Dowagiac, Mich. EXPERIMENTAL RESULTS IN THE REMOTE SENSING OF GASES FROM HIGH ALTITUDES

A. R. Barringer and J. H. Davies /In NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 2 1969 31 p
Avail. NTIS CSCL 20F

A brief history of correlation spectroscopy is provided. The continuing progress made in the experimental and theoretical development of techniques for remote sensing of trace gases by optical correlation methods is reviewed. The concept of correlation spectrometry has been improved by the use of computer techniques for correlation mask optimization, and the problems of atmospheric scattering are investigated in some detail. Theoretical work is matched against various types of remote-sensing measurements, including long horizontal-path measurements using active light sources and passive remote sensing from aircraft flying above the inversion layer. Good results were obtained in terms of monitoring patterns of pollution and tracking plumes, and methods are being developed for improving the absolute accuracy of measurements. A number of test airborne surveys of pollution were carried out over cities, and a high altitude balloon experiment was conducted.

Author

N71-14877# Comissao Nacional de Atividades Espaciais, Sao Jose Dos Campos (Brazil).

GEOGRAPHY AND URBAN STUDIES: REMOTE SENSING PROJECT, PHASE C Final Report

Aida O. Ferreira De Barros Sep. 1970 7 p
(LAFE-133) Avail: NTIS

The elements of the urban environment (geology, soils, vegetation) and of the urban structure (sociology, traffic and public safety with fire, flood, law enforcement, etc.), within global or sectorial characterizations (director plans, integrated urban-rural and geoeconomical plans) can be better interrelated by remote sensors which constitute the largest system capable of producing automatic procedures for management goals.

Author

N71-15509# Scott Research Labs., Inc., Plumsteadville, Pa. ATMOSPHERIC REACTION STUDIES IN THE LOS ANGELES BASIN, 1969. VOLUME 4: AIRBORNE DATA ESSA COOPERATIVE DATA Final Report, 18 Aug. - 14 Nov. 1969

18 Feb. 1970 308 p
(Contract PHS-CPA-70-6)
(PB-194084) Avail: NTIS CSCL 13B

Data for the chemical and meteorological parameters measured aloft during the 26 aircraft flights and for analyses performed on the Tedlar bag samples collected during vertical profiles are presented. The data from the continuous instruments were recorded at ten second intervals during profiles and at one minute intervals at other times. Occasional spurious readings, usually caused by interfering signals, must be disregarded. The first four flights were made before all the instrumentation was operational and were used for check-out purposes. Asterisks are placed between the UV columns when the aircraft was in level flight. Other UV readings are not necessarily valid. Altitudes recorded by the transducer have been corrected for barometric pressure and instrument error by empirical equations, and most residual errors are less than 50 feet.

Author (USGRDR)

N71-15548# Comissao Nacional de Atividades Espaciais, Sao Jose dos Campos (Brazil). Conselho Nacional de Pesquisas.

REMOTE SENSORS PROJECT: GEOGRAPHY AND URBANISM, VOLUME 2 Final Report of Phase C [PROJETO SENSORES REMOTOS: GEOGRAFIA E URBANISMO, VOLUME 2 (RELATORIO FINAL DA FASE 'C')]

Aida O. Ferreira de Barros Sep. 1970 68 p refs In
PORTUGUESE
(LAFE-133-Vol-2) Avail: NTIS

The verification of the geography in the Rio de Janeiro region by the use of airborne remote sensing equipment is presented as part of a global program to survey surface gradients and other natural resources. The observed data for selected test areas are analyzed.

Transl. by F.O.S.

N71-16128*# California Univ., Riverside, Dept. of Geography. SOUTHERN CALIFORNIA REGIONAL RESOURCES STUDIES

Leonard W. Bowden /In NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 1 1968 29 p
refs
Avail: NTIS CSCLO8F

Objectives of described tests were to correlate multisensor and ground-truth observations in order to evaluate the feasibility of sensors and sensor combinations as data gathering components of aircraft in the following areas: (1) land use; (2) urban problems; (3) surface energy balance; (4) soil moisture; (5) vegetation mapping; and (6) air pollution analysis. Summary evaluations of each sensor are given. Utilized were Ektachrome IR 8443 imagery, side-looking airborne radar, multiband photography, thermal infrared imagery, telescopic systems, and imaging passive microwave devices.

G.G.

N71-16129*# East Tennessee State Univ., Johnson City. LAND USE AND REGIONAL ANALYSIS

Robert W. Peplies /In NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 1 1968 21 p
refs
Avail: NTIS CSCL 08F

Results from five remote sensing overflights of a test site indicated the following: (1) color infrared photographs appear to be superior to Ektachrome and panchromatic photos for interpretation of rural land-use features; (2) radar image interpretations can be used to characterize areas in integrated landscapes; (3) radar images are useful for mapping linear features of topographic surfaces; (4) remote sensor imagery can determine trade areas and traffic flow; observations include black and white panchromatic, color, and color infrared films; (5) color and color infrared films can be utilized in pond and lake studies if the parameters that affect the variations of color on the film are controlled; (6) large scale infrared and color photographs identify slope failure forms; and (7) remote sensor data can be applied to urban and regional transportation and land-use planning.

G.G.

02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

N71-16131*# Northwestern Univ., Evanston, Ill. Dept. of Geography.

REMOTE SENSING AND THE STUDY AND PLANNING OF URBAN AREAS

Duane F. Marble and Frank E. Norton (Iowa Univ.) *In* NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 1 1968 13 p refs

Avail: NTIS CSCL08F

The application of aerial sensor technology to the identification of urban problems and urban planning is considered. Side-looking radar, thermal infrared scanners, and hyperaltitude photography are potential urban data sources for measuring the quality of residential environment from photographic images. A standard long-focal-length mapping camera placed on a satellite during earth orbit can be used to generate additional data points in low altitude aircraft imagery.

G.G.

N71-16132*# Kansas Univ., Lawrence. Dept. of Geography.

THEMATIC LAND-USE MAPPING WITH SPACECRAFT PHOTOGRAPHY AND RADAR

David S. Simonett *In* NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 1 1968 24 p refs

Avail: NTIS CSCL08B

Construction of thematic maps with spacecraft-derived photographs and with radar images obtained from aircraft with resolutions comparable to those anticipated from spacecraft is in progress. Preliminary studies are reported in a discussion of: (1) whether existing thematic land-use maps could be constructed with space data; (2) problems of constructing thematic land-use maps using space data; (3) information in Gemini photographs and in aircraft radar images; and (4) some aspects of the roles of photography and radar as complementary and supplementary sensors.

Author

N71-16168*# Geological Survey, Arlington, Va.

EFFECTS OF URBAN DEVELOPMENT ON THE HYDROLOGY OF LONG ISLAND, NEW YORK

E. J. Pluhowski *In* NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 3 1968 9 p

Avail: NTIS CSCL08F

The use of infrared imagery to detect changes in the thermal patterns of water bodies and nearby land areas, induced by urban development, is discussed. Analysis of the imagery is presented for wavelengths from 8 to 14 microns.

R.B.

N71-18878*# Avco-Everett Research Lab., Everett, Mass.

FEASIBILITY STUDY OF REMOTE MONITORING OF GAS POLLUTANT EMISSIONS BY RAMAN SPECTROSCOPY

Donald A. Leonard Dec. 1970 57 p refs

(Contract CPA-22-69-62)

(RR-362) Avail: Issuing Activity

The feasibility was determined for using laser Raman scattering to remotely monitor the emission of NO and SO₂ from large stationary sources such as electric power plants. No previous experimental measurement of the Raman scattering cross sections was known to have been made for either NO or SO₂, these cross sections were measured in the laboratory using a 3371 Å pulsed nitrogen laser as the Raman exciting source. Using N₂ as a normalizing standard, the results are best fit by a NO to N₂ Raman cross section ratio of 0.5 + or - 0.1 and a SO₂ to N₂ Raman cross section ratio of 2.4 + or - 0.3. A field study was carried out with a laser Raman spectrometer utilizing a 3371 Å pulsed nitrogen laser installed in a van at the site of a large electric power plant. Raman spectra of N₂, O₂, H₂O and CO₂ were obtained from the power plant stack plume at a slant range of 625 feet without interference, and detailed field procedures were developed which permit quantitative profiles of the concentration of these

molecules in the plume to be routinely obtained. However, NO and SO₂ were not observed in the field study, due primarily to the insufficient stray light rejection ratio of the monochromometer.

Author

N71-19264*# Kansas Univ., Lawrence. Dept. of Geography.

THEMATIC LAND USE MAPPING: SOME POTENTIALS AND PROBLEMS

David S. Simonett *In* NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 1 1969 43 p refs

Avail: NTIS HC\$6.00/MF\$0.95 CSCL08B

Project work is discussed in three broad groups. The first group involves studies using Gemini and Apollo photography for boundary and road detection. This is followed by three studies dealing with the feasibility of making existing thematic maps from spacecraft data, comments on the resolution needs for thematic maps in different environments, and a comparison of time available for radar and photographic imagery obtained over the United States. Statements are also given on the results to date of the analyses of NASA aircraft data obtained over the Garden City and Lawrence sites.

Author

N71-19265*# California Univ., Riverside. Dept. of Geography.

IMPERIAL VALLEY LAND USE STUDIES: A CONTINUUM FROM MISSION 73 TO APOLLO 9

Claude W. Johnson *In* NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 1 1969 10 p

Avail: NTIS HC\$6.00/MF\$0.95 CSCL08G

Data obtained from Apollo 9 helped produce some final stages in the long term program of geographic land use via remote sensing in the Imperial Valley. The combination of aircraft, spacecraft, laboratory, and field investigations has made the Imperial Valley an exceptionally productive test site in the acquisition and application of geographic data. Emphasis is on use of color infrared photography and its application to land use studies. However, experiments with multiband photography, side-looking radar imagery, passive microwave imagery, scatterometer data, and thermal infrared imagery were conducted and partially evaluated. A significant step was the application of Apollo 9 imagery to computerized programs (on land use) that developed from data acquired from Mission 73.

Author

N71-19266*# Iowa Univ., Iowa City.

HOUSING QUALITY IN URBAN AREAS: DATA ACQUISITION AND CLASSIFICATION THROUGH THE ANALYSIS OF REMOTE SENSOR IMAGERY

Frank E. Horton and Duane F. Marble (Northwestern Univ.) *In* NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 1 1969 13 p

Avail: NTIS HC\$6.00/MF\$0.95 CSCL14B

The potential of photographic sensors to contribute to the analysis and identification of housing quality areas in metropolitan regions is discussed. An analysis was made of ground truth data obtained from a survey conducted in the spring of 1968 covering some 1300 blocks in three districts in the Los Angeles area containing some of the county's worst housing. The imagery analysis consisted of an evaluation of black and white, and color infrared photography obtained as part of NASA Aircraft Mission 73 with respect to the identification of the reduced variable set. Color infrared photography was found to be the most useful in defining the seven variables important in housing quality identification. It is felt that small area classification of housing quality in the United States can be accomplished via aerial photography.

Author

02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

N71-19268* Geological Survey, Washington, D.C.

GEOGRAPHY PROGRAM REVIEW AND INTEGRATION

Robert H. Alexander *In* NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 1 1969 23 p

Avail: NTIS HC\$6.00/MF\$0.95 CSCLO8F

Recent research results in five areas are presented. (1) Land use changes and disaster effects were analyzed, and details are given on programs for Asheville Basin, Tennessee; Imperial Valley, California; and test sites in Florida. (2) Urban growth and environmental quality were monitored with respect to housing quality, air pollution, urban planning, urban change detection, and emergency preparedness. (3) Man-induced climatic changes were assessed with respect to surface heat and water balance. (4) Supplementary census information was obtained relative to the distribution of dwelling units and population in urban areas. (5) Small scale thematic maps were updated. Advances in other projects are also listed. N.E.N.

N71-19606* Spectran, Inc., Downey, Calif. Microwave Sensor Systems Div.

OIL POLLUTION DETECTION AND DISCRIMINATION BY REMOTE SENSING TECHNIQUES Final Report

Jerry C. Aukland and Dennis T. Trexler 15 Oct. 1970 178 p refs

(Contract DOT-CG-03523)

(AD-716349; Rept-1001-F; USCG-714104/a/006-1) Avail: NTIS CSCL 13/2

Airborne remote sensing techniques were applied to the detection and discrimination of pollution by oil on the ocean surface. The tests were performed in the Gulf of Mexico during April, 1970. Pollutants investigated included No. 2 fuel oil, No. 6 fuel oil, 9250 lube oil, light crude oil, heavy crude oil, gasoline, and mixtures of gasoline and oil. A total of 103 oil slicks were produced as a function of spill rate and ship speed. Ship speeds were nominally 10, 14, and 17 knots and spill rates ranged from 0.02 to greater than 4.0 GPM (Gallons per Minute). Sensors used during the airborne tests included: two dual polarized microwave radiometers operating at 10.2 and 30 GHz, an infrared scanner operated in both the 4-5.5 microns and 8-14 microns regions, a dual 70 mm camera sensing visible color and infrared color, a 4-lens camera employing filters from the mid-visible to ultraviolet wavelengths. Oil was detected on the sea surface at spill rates as low as 0.2 GPM for long wavelengths sensors and at the lowest spill rates for photographic imagery using an ultraviolet filter. Anomalous warm infrared radiometric temperatures were recorded in the 4-5.5 micron region for heavy crude oil while No. 6 fuel oil appeared radiometrically cooler. Author (GRA)

N71-21304* Coast Guard, Washington, D.C. Applied Technology Div.

RESULTS OF OVERFLIGHTS OF CHEVRON OIL SPILL IN GULF OF MEXICO Final Report

Clarence E. Catoe 24 Aug. 1970 20 p refs Sponsored by NASA Original Contains Color Illustrations

(NASA-CR-117497; AD-714681) Avail: NTIS CSCL 14/5

The NASA 927, Earth Resources Aircraft, at Coast Guard request, flew over the Chevron Oil Spill on 18 March 1970, during the day and night. The aircraft was equipped with photographic, infrared, and radar type systems, which collected the data in the oil spill area. Ground truth data during these overflights was collected by Coast Guard personnel and a team of oceanographers from Louisiana State University. The initial data received from NASA, Manned Spacecraft Center was restricted to photographic and 8 to 14 micrometer scanner data. The preliminary analysis of the test results obtained is limited to the above mentioned applicable sensors. Author (GRA)

N71-21446* Michigan Univ., Ann Arbor. Willow Run Labs.

MULTISPECTRAL REMOTE SENSING OF URBAN FEATURES Final Report, 1 Jun. -31 Oct. 1969

J. E. Colwell Mar. 1970 27 p refs Original contains color illustrations

(Contract USGS-14-08-0001-11968)

(Rept-2772-6-F) Avail: Issuing Activity

The potential of multispectral remote sensing in aiding the study of changing urban watershed characteristics resulting from fluctuations in the materials comprising the watershed was investigated. Multispectral data was collected in three separate sets, each containing information from different spectral regions. The data was processed on special-purpose analog and digital computers, and the results are presented in the form of recognition maps, resolution-element counts, and mean reflectance spectra. The spectral interval from 1.0 to 5.5 micrometers provided the most promising single data set. Results suggest that information concerning the area and distribution of the materials present in an urban scene can be most reliably and completely obtained by the simultaneous processing of both reflected and emitted data. Author

N71-24086* Geological Survey, Washington, D.C.

THE USE OF AIR PHOTO MOSAICS AS SIMULATORS OF SPACECRAFT PHOTOGRAPHY IN LAND USE MAPPING

R. D. Rudd (Oregon State Univ.) and R. M. Highsmith, Jr. (Oregon State Univ.) Jan. 1970 27 p refs

(NASA Order W-12572)

(NASA-CR-106253; PB-194811; USGS-DO-70-008;

IR-USGS-194) Avail: NTIS CSCL 08B

The study investigates some of the potential limitations on land use mapping in the Pacific Northwest which may result from the anticipated small scale of future orbital imagery. Since high resolution orbital altitude photography of the area is routinely unavailable, a 1:400,000 photomosaic is used in simulation. Two scales of mapping are carried out and tested: general macro land use and thematic agricultural land use. The only magnification employed was that achieved through the use of a 2x hand lens during the mapping. Substantial mapping potential is indicated despite the small scale of the photomosaic and a mapping classification is proposed. Author (GRA)

N71-24087* Geological Survey, Washington, D.C.

APPLICATION OF REMOTE SENSING TECHNIQUES TO WATER ORIENTED OUTDOOR RECREATION PLANNING

Robert W. Douglass (Penn. State Univ., Mont Alto) Jan. 1970 21 p refs

(NASA Order W-12572)

(NASA-CR-107636; PB-194810; USGS-DO-70-006;

IR-USGS-191; TR-69-2) Avail: NTIS CSCL 08B

The document is concerned with high altitude, small scale photography as a tool for evaluating potential water based recreation sites. Potential recreation sites adjacent to the proposed lake at the Tellico project on the Little Tennessee River were evaluated. Aircraft took photographs at approximately 1:21,300 in October 1968. The images produced were infrared transparencies that were arranged on the roll to prevent stereoscopic interpretation. Success at this scale and flying height indicate merit in continuing with high elevation, small-scale photography. Author (GRA)

N71-26318* Geological Survey, Washington, D.C.

SATELLITE PHOTOGRAPHY AS A GEOGRAPHIC TOOL FOR LAND USE MAPPING OF THE SOUTHWESTERN UNITED STATES Technical Report, 1 Jul. 1968 31 Jan. 1970

Norman J. W. Thrower (Calif. Univ., Los Angeles), Leslie W. Senger (Calif. Univ., Los Angeles), Robert H. Mullens, II (Calif. Univ., Los Angeles), and Keith J. Walton (Calif. Univ., Los Angeles) Jan 1970 22 p refs Prepared by Assoc. of Am. Geographers

(NASA Order W-12572)

(NASA-CR-118518; USGS-193; TR-69-3) Avail: NTIS CSCL 08E

The utility of satellite photography for generalized land use mapping at intermediate and small map scales was investigated. Photography of the southwestern United States from the Gemini and Apollo missions was used to determine what land uses are visible on satellite photography, devise a land use classification system compatible with data obtainable from such imagery, and construct land use maps at scales of 1:250,000 and 1:1,000,000. Various land use categories are interpretable from the photography, although some are difficult to distinguish (e.g., unimproved grazing land and woodland). Accuracy was found to be a function of the degree of dependence on spectral characteristics and the consequent amount of inference necessary for an interpretation. The photography proved a useful data source when supplemented by limited field investigations and the geographical knowledge of the investigators.

Author

N71-26796* Geological Survey, Washington, D.C. Geographic Applications Program.

PRODUCTION OF A HIGH ALTITUDE LAND USE MAP AND DATA BASE FOR BOSTON Interim Report, Jun. - Dec. 1970

Robert B. Simpson (Dartmouth Coll.) Dec. 1970 46 p refs (NASA Order W-13165; Contract D1-14-08-0001-12640) (NASA-CR-118670; IR-4SGS-205) Avail: NTIS CSCL 08B

Data are presented on production of the map of the Boston area proper from CIR photography taken at 60,000 feet under the NASA Earth Resources Aircraft program in September 1969, and establishes an initial computer compatible data base. The Boston map and one for Washington, D.C., are designed to serve as prototypes for the proposed national 26-city program in urban change detection, which ultimately will utilize data from ERTS. In the creation of the Boston map reliance on the photo interpreter and photo laboratory has been emphasized. The data bank uses a basic map cell which is quite small (0.2 km on a side) and is UTM addressable. An initial experimental drawing of the Boston area urban-rural interface is provided.

Author

N71-33212* Geological Survey, Washington, D.C. **GEOGRAPHIC EVALUATION OF RADAR IMAGERY OF NEW ENGLAND**

Robert B. Simpson (Dartmouth Coll.) Sep. 1969 50 p refs (NASA Order W-12572; Grant USGS-14-08-0001-G-8) (NASA-CR-121426; Rept-163) Avail: NTIS CSCL 171

Certain pre-existing, K-band, dual-polarized radar imagery of New England is evaluated. The capability of radar to reveal the density and distribution of population through revealing the size, shape and distribution of built-up areas is examined. Limiting factors in interpretation include not only those associated with the radar itself, but also those resulting from the complex clutter of the New England landscape. Assuming that the results are statistically valid it is concluded that radar permits a typical interpreter to find 74% of the populated places of New England, including all cities of over 7,000 population; 80% of the towns having 800 to 7,000 people; and 40% of the hamlets of 150 to 800 people. Signatures in the fields of hydrography, surface configuration, transportation and agricultural land use are discussed briefly. A table is presented for summarizing the confidence level that can be placed on the consistency of selected landscape items to leave signatures.

Author

N71-33537* Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.

ENVIRONMENTAL AIR QUALITY SUPPORT STUDY. ACCOMPLISHMENTS THROUGH FY 1970

T. W. Nybakken Jul. 1970 24 p refs Sponsored by AEC (EGG-1183-2242) Avail: NTIS

The problem of environmental air quality is examined. The major serious pollutants considered are ozone, nitrogen oxides, sulfur oxides, and oxides of carbon. Considerations are presented for the development of global air quality standards. A worldwide

system of surveillance and monitoring is suggested using a long range jet aircraft as the mobile instrument platform.

Author

N71-34340* Wisconsin Univ., Madison. Space Sciences and Engineering Center.

STUDIES ON TECHNIQUES FOR SATELLITE SURVEILLANCE OF GLOBAL ATMOSPHERIC POLLUTION Final Report, 1 Sep. 1969 - 31 Jul. 1970

Michael McClintock, T. A. Hariharan, and Alden McLellan, IV Sep. 1970 93 p refs

(Contract CPA-22-69-101)

(PB-198821; APTD-0672) Avail: NTIS CSCL 13B

Research on the feasibility of using satellites to study air pollution is discussed. The following areas are considered: remote sensing of particulates; the possibility of calibrating the intensity of specularly reflected sunlight and using this optical source to measure the spectral turbidity of the atmosphere; turbidity from ATS measurements; techniques for remote sensing of gaseous air pollutants; measurement of Co from the SMS Satellite; and the application of lasers to air pollution research.

GRA

N71-34360* Geological Survey, Washington, D.C.

RECOGNITION OF SETTLEMENT PATTERNS AGAINST A COMPLEX BACKGROUND

Robert B. Simpson and David T. Lindgren May 1970 42 p refs Prepared in cooperation with Dartmouth Coll.

(NASA Order W-12570; NASA Order W-12572; Contract D1-14-08-0001-G-8)

(NASA-CR-121652; USGS-208) Avail: NTIS CSCL 14E

The application of aerial photointerpretation procedures to urban analysis to the estimation of dwelling units in areas of high population density is discussed. Color infrared photography of metropolitan Boston of a scale 1:20,000 was examined and found to be capable of providing the signatures necessary for making accurate dwelling unit estimates.

Author

N71-35447* Purdue Univ., Lafayette, Ind. Joint Highway Research Project.

REMOTE SENSING AND DEVELOPMENT OF ANNOTATED AERIAL PHOTOGRAPHS AS MASTER SOIL PLANS FOR PROPOSED HIGHWAYS Final Report

Robert D. Miles, Harold T. Rib, and Marc G. Tanguay 16 Jul. 1970 60 p refs

(PB-199422) Avail: NTIS CSCL 08B

The application of remote sensing systems to the development of master engineering soil plans is discussed. The remote sensing systems consisted of aerial photography, infrared imagery, side-looking airborne radar imagery and multispectral imagery. The multispectral analog data were used in conjunction with a digital computer to semi-automatically produce thematic maps and statistical analysis of reflectance of surfaces. Inference techniques were used to evaluate the photography and imagery.

Author (GRA)

N71-35528* Oregon State Univ., Corvallis. Dept. of Civil Engineering.

AERIAL PHOTOGRAPHIC TRACING OF PULP MILL EFFLUENT IN MARINE WATERS

Fred J. Burgess and Wesley P. James Aug. 1970 162 p refs (Grant WP-00524)

(Rept-12040E8Y) Avail: SOD \$1.25

Aerial photography taken of waste plumes from pulp mill ocean outfalls was shown to be an effective tool in the study of waste disposal sites. This technique is not limited by sea conditions and permits monitoring and evaluation of outfall sites throughout the year. Photography taken at one instant provides comprehensive information throughout the waste field. Manpower requirements and costs for this method are considerably less than for conventional boat sampling surveys. Waste concentrations were measured by conventional boat sampling techniques while aerial photography was taken of the outfall area from altitudes ranging from 3,000 to 11,000 ft.

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Computerized procedures were used to compute water currents, waste concentrations, toxicity zones and diffusion coefficients from the photography. Surface water current was found to be the dominant factor in the resulting plume pattern. Temperature was found not to be an effective tracer for tracking the plume or for estimating waste concentrations since the resulting plume temperature may be greater than, less than or equal to the surrounding ocean temperature. Author

N71-36386# National Industrial Pollution Control Council, Washington, D.C.
THE ENGINEER'S RESPONSIBILITY IN ENVIRONMENTAL POLLUTION CONTROL
Mar. 1971 19 p
Avail: NTIS

The engineer's responsibilities toward protection and control of the environment are studied. The recommended duties the engineer should assume include: coordinate and unify control efforts, provide technical leadership, evaluate costs of pollution control, identify manpower needs, and participate in the development of a national commitment. F.O.S.

N72-10273*# Biospherics, Inc., Rockville, Md.
STUDY OF THE POSSIBLE ROLE OF POLLUTION IN THE PREVALENCE OF SEA NETTLES IN THE CHESAPEAKE BAY AND THE DEVELOPMENT OF A CENSUS TAKING METHOD Final Report
15 Oct. 1971 137 p refs Original contains color illustrations (Contract NASw-2115)
(NASA-CR-123293) Avail: NTIS CSCL 08A

A study of the effect of pollutants on the sea nettle population of Chesapeake Bay was conducted. The effects of pollutants on the polyp stage of the nettle were stressed. Methods of detecting adult sea nettles by remote sensing are discussed. The effects of phosphate, nitrate, ammonium, and combinations of these pollutants were investigated. Author

N72-12250*# Geological Survey, Washington, D.C.
CENSUS CITIES PROJECT AND ATLAS OF URBAN AND REGIONAL CHANGE c34
James R. Wray /In NASA, Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 16 p

Avail: NTIS CSCL 05K

The research design and imagery utilization for urban applications of remote sensing are reviewed, including the combined use of sensor and census data and aircraft and spacecraft sensor platforms. The related purposes of the Census Cities Project are elucidated: (1) to assess the role of remote sensors on high altitude platforms for comparative study of urban areas; (2) to detect changes in selected U.S. urban areas between the 1970 census and the time of launching of an earth-orbiting sensor platform prior to next census; (3) to test the satellite sensor platform utility to monitor urban change and serve as a control for sensor image interpretation; (4) to design an information system for incorporating graphic sensor data with census-type data gathered by traditional techniques; (5) to identify and to design user-oriented end-products or information services; and (6) to ascertain what organizational capability would be needed to provide such services on a continuing basis. A need to develop not only a spatial data information system, but also a methodology for detecting and interpreting change is implied. J.A.M.

N72-12251*# Iowa Univ., Iowa City. Inst. of Urban and Regional Research.
THE APPLICATION OF REMOTE SENSING TECHNIQUES TO SELECTED INTER AND INTRA URBAN DATA ACQUISITION PROBLEMS c24
Frank E. Horton /In NASA, Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 12 p

Avail: NTIS CSCL 05K

The utility of remote sensing techniques to urban data acquisition problems in several distinct areas was identified. This endeavor included a comparison of remote sensing systems for urban data collection, the extraction of housing quality data from aerial photography, utilization of photographic sensors in urban transportation studies, urban change detection, space photography utilization, and an application of remote sensing techniques to the acquisition of data concerning intra-urban commercial centers. The systematic evaluation of variable extraction for urban modeling and planning at several different scales, and the model derivation for identifying and predicting economic growth and change within a regional system of cities are also studied. J.A.M.

N72-12252*# California Univ., Riverside. Dept. of Geography.
CLIMATOLOGY OF URBAN REGIONAL SYSTEMS
Robert W. Pease /In NASA, Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 11 p refs.

Avail: NTIS CSCL 04A

The combining of remote sensing technologies to urban-regional energy climatology is studied. It was found to be three dimensional with a mosaic urban surface, each smaller surface with its own radiant and thermal properties. Urban patterns of radiant exchange were found to be constantly changing during diurnal and annual cycles. Results were derived from Barbados data using remote methods for monitoring and mapping radiation. Isoline maps of terrestrial radiation patterns were made generalizing the minute patterns of the scan image. J.A.M.

N72-12253*# Geological Survey, Washington, D.C.
REGIONAL LAND USE STUDIES
John L. Place /In NASA, Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 9 p

Avail: NTIS CSCL 02B

Remote sensing technology and data from instrumented satellites and high altitude aircraft are proposed for mapping land use on a current national basis, for monitoring changes and trends, and for creating statistical models which can be manipulated to demonstrate the probable effects of proposed land use and of environmental changes over large areas. Both Apollo spacecraft and aircraft photography were used; the spacecraft pictures delineated the cropland and urban boundaries more clearly. A computer model is also proposed for statistical analysis and for printing out updated maps automatically; this model will include a data bank which can be updated rapidly with changes detected by the computer. J.A.M.

N72-12254*# Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
ENVIRONMENTAL APPLICATION OF REMOTE SENSING METHODS TO COASTAL ZONE LAND USE AND MARINE RESOURCES MANAGEMENT
H. G. Goodell /In NASA, Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 9 p

Avail: NTIS CSCL 08C

The interrelationships of biophysical environmental systems are investigated. Social decision-making affecting the environments of a coastal megapolis are examined. Remote sensing from high altitude aircraft and satellites afforded a powerful and indispensable tool for inventory and planning for urban development. Repetitive low to medium altitude photography is also used for studying environmental dynamics, and to document the cultural impact of man on his environment. J.A.M.

N72-12256*# Geological Survey, Washington, D.C.
SPECIAL PROJECTS OF THE GEOGRAPHIC APPLICATIONS PROGRAM
Gray W. North /In NASA, Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 7 p refs

Avail: NTIS CSCL 08F

Alternative uses were investigated for the Mississippi Test Facility since the phaseout of Saturn 5 engine testing. Using the

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facility for collecting remotely sensed data is suggested for regional studies. The capabilities of various remote sensing devices to detect, identify, monitor, or determine effects of environmental pollution are summarized. Which pollutants could be monitored from spacecraft, high and low altitude aircraft, and ground based platforms are determined. Examples of special processing and enhancement and analysis techniques used in connection with remote sensing data are provided. J.A.M.

N72-12311*# Naval Research Lab., Washington, D.C.

RADAR MONITORING OF OIL POLLUTION

N. W. Guinard /in NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 1 p (See N72-12295 03-13)

Avail: NTIS HC \$6.00/MF \$0.95

Radar is currently used for detecting and monitoring oil slicks on the sea surface. The four-frequency radar system is used to acquire synthetic aperture imagery of the sea surface on which the oil slicks appear as a nonreflecting area on the surface surrounded by the usual sea return. The value of this technique was demonstrated, when the four-frequency radar system was used to image the oil spill of tanker which has wrecked. Imagery was acquired on both linear polarization (horizontal, vertical) for frequencies of 428, 1228, and 8910 megahertz. Vertical returns strongly indicated the presence of oil while horizontal returns failed to detect the slicks. Such a result is characteristic of the return from the sea and cannot presently be interpreted as characteristics of oil spills. Because an airborne imaging radar is capable of providing a wide-swath coverage under almost all weather conditions, it offers promise in the development of a pollution-monitoring system that can provide a coastal watch for oil slicks. Author

N72-12312*# TRW Systems Group, Redondo Beach, Calif.

VISIBLE REGION REMOTE SPECTROSCOPY OF POLLUTED WATER

Peter G. White /in NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 15 p
Avail: NTIS HC \$6.00/MF \$0.95 CSCL 14E

The use of an airborne spectrometer for measuring the amount of pollutants under the surface of a body of water is discussed. Difficulties created by high water absorption, atmospheric absorption, molecular scattering by water, and atmospheric scattering for the range of wavelengths from 0.2 to 20.0 microns are described. It was determined that some form of quantitative measurement of subsurface pollutants is possible using an airborne spectrometer. Author

N72-12322*# National Aeronautics and Space Administration, Washington, D.C.

MAN-MADE ENVIRONMENT AS VIEWED FROM SPACE: WATER AND AIR POLLUTION

B. V. Vinogradov Nov. 1971 16 p refs Transl. into ENGLISH of Leningrad Univ. conf. paper p 1-16 Presented at the 22d Intern. Astronaut. Federation Congr., Brussels, Sep. 1971 (NASA-TT-F-14079) Avail: NTIS CSCL 13B

Detection and observation of air and water pollution using spaceborne sensors and manned spacecraft are discussed. Also, the requirement for development of a wide international program of observation and cooperation in the field of space surveillance and detection of the negative forms of man's influence on the environment is delineated. The development of such a global protection service will require that it be based on space methods whose applications transcend state and regional boundaries. A.L.

N72-12330*# Metropolitan Washington Council of Governments, D.C.

LAND USE DETERMINATION BY REMOTE SENSOR ANALYSIS

Harry J. Mallon and Joan Y. Howard Aug. 1971 74 p refs (NASA Order W-13318; Contract DI-14-08-0001-12708) (NASA-CR-124607; NASA-Task-160-75-71-03; IR-USGS-220) Avail: NTIS CSCL 08G

A land use analysis of 18 selected census tracts in the Metropolitan Washington area using aerial photography was undertaken. A comparison of the results was made with comparable land use data from the Metropolitan Washington Council of Governments' Parcel File, and the results reported. Summary conclusions and recommendations for the use of photo-derived data in land use studies by COG are made.

Author

N72-12341*# California Univ., Riverside.

STUDIES IN REMOTE SENSING OF SOUTHERN CALIFORNIA AND RELATED ENVIRONMENTS Final Report

Leonard W. Bowden Aug. 1971 21 p

(NASA Order W-12570)

(NASA-CR-124842; USGS-222;) Avail: NTIS CSCL 08G

A summary is presented of the research activities in southern California to determine whether meaningful geographic information was obtainable by use of remote sensing in an area already well documented or if the techniques and methodology could be transferred to related environments. Several broad characteristics of the regional geography were investigated with regards to their feasibility to be studied by aircraft and spacecraft sensors to improve the inventory and understanding of resources and environmental circumstances and to serve as models for future geographic analysis of other regions when using remote sensing devices. Sample activities are described in detail and three experiments producing worthwhile results are highlighted: mapping montane vegetation with color IR imagery, analysis of urban residual environment using color IR aerial photography, and regional agricultural land use mapping tested against color IR photography. Author

N72-12547*# National Aeronautics and Space Administration, Washington, D.C.

METEOROLOGICAL ASPECTS OF ATMOSPHERIC POLLUTION AND POSSIBILITIES OF OBSERVATION FROM SPACE

K. Ya. Kondratyev and Kh. Yu. Niylik Nov. 1971 32 p refs Transl. into ENGLISH from Russian report Presented at the 22d Intern. Astronautical Federation Congr., Brussels, Sep. 1971 (NASA-TT-F-14080) Avail: NTIS CSCL 04B

The results of studies are discussed of air pollution on the planetary scale, in terms of its meteorological aspects, and the prospects of remote detection of atmospheric and oceanic pollution from space. The main gaseous pollutants of the atmosphere are considered to be sulfur, nitrogen, and carbon compounds. CO₂ is of special importance as changes in CO₂ concentration lead to changes in atmospheric thermal radiation. The effects of water vapor on the radiation budget are also considered. Other topics discussed include: aerosol components, remote (satellite) methods for determining atmospheric pollution components, and thermal anomalies of industrial origin. F.O.S.

N72-14365# Department of Energy, Mines and Resources, Ottawa (Ontario).

RESOURCE SATELLITES AND REMOTE AIRBORNE SENSING FOR CANADA. REPORT NO. 3: ATMOSPHERIC CONSTITUENTS

Dennis White, ed. 1971 38 p refs

(M75-2/3) Avail: NTIS

The conclusions and recommendations of the Working Group on Atmospheric Constituents regarding the future role of Canada in the development of remote sensing, and its application to the problems of air pollution, are presented. Problem areas that appear amenable to study by remote-sensing methods are identified, an order of priority established, and existing and proposed instrumentation assessed. The Working Group has concluded that remote sensing from both orbital and aircraft platforms will undoubtedly play an important role in global and large-scale studies of pollutants and other atmospheric components, as suitable instrumentation becomes available. However, because of inadequate resolution, remote-sensing techniques will not replace ground-based local sampling in air quality management programs. Background papers prepared for the Working Group are included. Author

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N72-14402# Aerojet-General Corp., El Monte, Calif. Microwave Div.

MICROWAVE RADIOMETRIC DETECTION OF OIL SLICKS

Final Report, 12 Jun. 1970 - 28 Feb. 1971

D. C. Meeks, D. P. Williams, R. M. Wilcox, and A. T. Edgerton
Mar. 1971 103 p refs

(Contract DOT-CG-93228-A; USCG Proj. 714104/A/002)

(AD-728551; AGC-1335-2; FR-2) Avail: NTIS CSCL 13/2

Two years of research have been conducted to determine the feasibility of using microwave radiometry for the detection, identification, and surveillance of oil pollution. Theoretical studies consisted of a review of contemporary theory concerning parameters that influence microwave emission from both unpolluted and oil-covered seas. Laboratory investigations confirm results obtained from earlier studies and established the response characteristics of the 3.2-mm sensor to continuous oil films. Airborne measurements of controlled spills off the Southern California Coast were performed with dual-polarized 3.2- and 8.1-mm sensors oriented with a forward antenna viewing angle 45 deg above nadir. Four sets of oil spills, or missions, were performed to obtain data over a variety of sea-surface conditions. Pollutants used for the tests included No. 2 diesel fuel, 26.1 and 21.6 API gravity crude oils, and 9.7 API gravity fuel oil. Significant microwave brightness temperature oil slick signatures were noted for a wide range of ocean conditions (sea states 1-4) and oil film thickness (thickness + 1 micron and greater). Based on the experimental results a passive microwave imaging system configuration has been recommended for oil pollution surveillance. Author (GRA)

N72-14478# Coast Guard, Washington, D.C. Applied Technology Div.

THE APPLICABILITY OF REMOTE SENSOR TECHNIQUES FOR OIL SLICK DETECTION

Clarence E. Catoe 25 Feb. 1971 29 p refs

(CG Proj. 714104)

(AD-728422; USCG-71404-(A)-009) Avail: NTIS CSCL 13/2

The applicability of remote sensing techniques to the detection of oil films on water is furnished. Short reviews of various imaging techniques and their feasibility as oil film detectors are provided. The results of Coast Guard sponsored research to develop characteristics signatures for sensors operating in the UV to microwave of the electromagnetic spectrum are given. Field test results of existing passive and active sensors obtained from oil spill overflights is presented. Author (GRA)

N72-15383* Dartmouth Coll., Hanover, N.H. Dept. of Geography.

COLOR INFRARED (CIR) PHOTOGRAPHY: A TOOL FOR ENVIRONMENTAL ANALYSIS

David T. Lindgren Aug. 1971 42 p refs Prepared for Geol. Surv., Washington, D. C.

(NASA Order W-13318; Contract DI-14-08-0001-129-58; Task-160-75-71-03)

(NASA-CR-125288; PB-204472; IR-USGS-219) Avail: NTIS In color MF only. This document is not available from the NASA Scientific and Technical Information Facility, College Park, Md. CSCL 08F

Research carried out under NASA auspices suggests that in the future remote sensors may play an important role in monitoring our environment. One medium, color infrared photography, appears to have immediate utility. Its capability to identify, measure the acreage of, and monitor the health of agricultural and woodland resources has been demonstrated, as has its capability to identify the sources and extent of certain types of water pollution. CIR is also beginning to demonstrate considerable potential as a tool for urban analysis. The great value of CIR is that it can provide these data quickly and inexpensively, and for that reason will be preferred to more complex multispectral systems by budget-conscious administrators. Author

N72-16097# Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (West Germany).

PROPAGATION EFFECTS ON MONITORING ATMOSPHERIC FINE STRUCTURE USING SIDE SCATTER ON APPROPRIATE FREQUENCIES

H. J. Albrecht and M. Piening In AGARD Propagation Limitations in Remote Sensing Oct. 1971 7 p refs

Avail: NTIS HC \$6.00/MF \$0.95

The possibilities of extending side-scatter analysis to higher frequencies are examined with regard to the very timely subject of monitoring air pollution above industrial areas, cities, and other exposed areas. The limits of detecting appropriate element sizes as well as the combination of such methods with turbulence analysis by side-scatter are considered for the purpose of estimating the degree of danger and its variation.

Author

N72-17272# International Business Machines Corp., Gaithersburg, Md. Federal Systems Div.

THE ROLE OF APPLICATIONS SATELLITES IN THE MANAGEMENT OF THE HUMAN ENVIRONMENT

Peter A. Castruccio Jun. 1971 28 p Presented at IAF Congr., Brussels, Sep. 1971

(FSC-71-6011) Avail: NTIS

Examples of existing ecological models in selected areas, such as oceanography and hydrology, are presented. Their objectives, mode of operation, and types of input data requirements are described. Avenues for significant improvement in the model's predictive accuracy and for reduction via remote sensing of the cost of gathering the necessary data, are analyzed.

Author

N72-17310# Illinois Inst. for Environmental Quality, Chicago.

MERCURY VAPOR EMISSIONS: REPORT ON AERIAL SURVEY OF SOURCES POTENTIALLY AFFECTING THE AIR IN ILLINOIS Final Report

William D. Vaughan and Stephen P. Fuller Jun. 1971 20 p refs

(PB-204520; IEQ-71-3) Avail: NTIS CSCL 13B

The survey demonstrated the feasibility of rapid aerial detection of mercury emitters. It showed that fossil fuel burning power plants, municipal incinerators, and several industrial sites are emitting measurable quantities of elemental mercury vapor. Estimates of annual mercury vapor output range from 100 lbs/yr to 5,400 lbs/yr for individual sites. Author (GRA)

N72-17498# Transportation Systems Center, Cambridge, Mass. AN INVESTIGATION OF OIL FLUORESCENCE AS A TECHNIQUE FOR THE REMOTE SENSING OF OIL Final Technical Report, 1 Jul. 1970 - 30 Jun. 1971

John F. Fantasia, Thomas M. Hard, and Hector C. Ingrao 30 Jun. 1971 127 p refs

(PB-203585; TSC-USCG-71-7) Avail: NTIS CSCL 13B

The feasibility of remote sensing of oil spills by laser-excited oil fluorescence was investigated. The required parameters were measured in the laboratory; these parameters were fed into a physical model to predict signal and background levels; and the this bibliography are Corporate Author, Monitoring Agency, Subject, and Title indexes. Author (GRA)

N72-18162* Illinois Univ., Urbana. Dept. of Geography.

RADAR AS A TOOL FOR REGIONAL INVESTIGATIONS

Nelson R. Nunnally Feb. 1969 30 p refs Prepared in cooperation with Geol. Surv.

(NASA Order R-09-020-024)

(NASA-CR-125634; USGS-IR-NASA-67) Avail: NTIS CSCL 17I

Radar is considered as a means for delimiting associations of physical and cultural phenomena by outlining image variation in tone, texture, pattern, and shape. Classification and description of landscape types are discussed. The imagery used for the study covers a portion of the Asheville Basin in North Carolina, extending from Hot Springs to an area southeast of Hendersonville. Eleven regions are discussed. K.P.D.

N72-18313 Centre National d'Etudes Spatiales, Paris (France).
**REMOTE SENSING AND ECOLOGY [TELED ET ECTION
 ET ECOGRAPHIE]**

A. Alouges and C. Rossetti / In ESRO Consultants Report on the Requirements and Recommendations for a European Programme in the Remote Sensing of Earth Resources Oct. 1971 p 36-47
 In FRENCH

Avail: Issuing Activity

The use of remote techniques for the sensing of the earth's surface is introduced. Some earth resources remote sensors available in France are reviewed, as well as the experiments using instruments onboard aircraft or balloons. The possible role of ESRO in a European program for the realization of a station receiving and pre-processing US meteorological satellite images is considered. ESRO

N72-18324* National Aeronautics and Space Administration.
 Langley Research Center, Langley Station, Va.
REMOTE MEASUREMENT OF POLLUTION

Washington 1971 261 p refs
 (NASA-SP-285) Avail: NTIS CSCL 14B

A summary of the major conclusions and recommendations developed by the panels on gaseous air pollution, water pollution, and particulate air pollution is presented. It becomes evident that many of the trace gases are amenable to remote sensing; that certain water pollutants can be measured by remote techniques, but their number is limited; and that a similar approach to the remote measurement of specific particulate pollutants will follow only after understanding of their physical, chemical, and radiative properties is improved. It is also clear that remote sensing can provide essential information in all three categories that can not be obtained by any other means. Author

N72-18334* California Univ., Berkeley.
**ANALYSIS OF EARTH RESOURCES IN THE PHOENIX,
 ARIZONA, AREA**

David M. Carnegie, Lawrence R. Pettinger, and Claire M. Hay / In its Monitoring Earth Resources from Aircraft and Spacecraft 1971 p 15-64 refs Original contains color illustrations

Avail: NTIS; SOD \$4.00 CSCL 08G

An analysis of earth resources around Phoenix, Arizona, measured by Apollo 9 photographs and sequential photographs from high altitude aircraft is presented. The analysis includes data for agriculture, range, geologic, hydrologic, and cultural resources. Major efforts were made to determine the usefulness and/or limitations of such photography for evaluating and monitoring earth resources. E.H.W.

N72-18338* California Univ., Berkeley.
**A LAND-USE CLASSIFICATION SYSTEM FROM APOLLO
 9 PHOTOGRAPHS FOR THE MISSISSIPPI-LOUISIANA
 AREA**

Robin I. Welch, Lawrence R. Pettinger, and Edwin H. Roberts / In its Monitoring Earth Resources from Aircraft and Spacecraft 1971 p 117-127 Original contains color illustrations

Avail: NTIS; SOD \$4.00 CSCL 02F

The photorecognition potential of photographs taken of the Mississippi Louisiana area by Apollo 9 is investigated. Studies show the following features were recognized: (1) deciduous forest, (2) pine forest, (3) mixed deciduous and pine forest, (4) cultivated land including bare ground, vegetation covered ground, and fallow ground, (5) open bodies of water (lakes, reservoirs, etc.) (6) rivers and canals, (7) urban and industrial areas, and (8) major roads. E.H.W.

N72-18345* South Dakota State Univ., Brookings. Remote Sensing Inst.

**REMOTE SENSING OF SOILS, LAND FORMS, AND LAND
 USE IN THE NORTHERN GREAT PLAINS IN PREPARA-
 TION FOR ERTS APPLICATIONS**

C. J. Frazee, F. C. Westin, J. Gropper, and V. I. Myers Feb. 1972 28 p refs Original contains color illustrations
 (Grant NGL-42-003-007)

(NASA-CR-125667; RSI-72-02) Avail: NTIS CSCL 08G

Research to determine the optimum time or season for obtaining imagery to identify and map soil limitations was conducted in the proposed Oahe irrigation project area in South Dakota. The optimum time for securing photographs or imagery is when the soil surface patterns are most apparent. For cultivated areas similar to the study area, May is the optimum time. The density slicing analysis of the May image provided additional and more accurate information than did the existing soil map. The soil boundaries were more accurately located. The use of a density analysis system for an operational soil survey has not been tested, but is obviously dependent upon securing excellent photographs for interpretation. The colors or densities of photographs will have to be corrected for sun angle effects, vignetting effects, and processing to have maximum effectiveness for mapping soil limitations. Rangeland sites were established in Bennett County, South Dakota to determine the usefulness of ERTS imagery. Imagery from these areas was interpreted for land use and drainage patterns. Author

N72-18350* California Univ., Los Angeles.
**ANALYSIS OF URBAN RESIDENTIAL ENVIRONMENTS
 USING COLOR INFRARED AERIAL PHOTOGRAPHY: AN
 EXAMINATION OF SOCIOECONOMIC VARIABLES AND
 PHYSICAL CHARACTERISTICS OF SELECTED AREAS IN
 THE LOS ANGELES BASIN, WITH ADDENDUM: AN
 APPLICATION OF THE CONCEPTS OF THE LOS ANGELES
 RESIDENTIAL ENVIRONMENT STUDY TO THE ONTARIO-
 UPLAND REGION OF CALIFORNIA**

Robert H. Mullens, Jr. and Leslie W. Senger (Calif. Univ., Los Angeles) May 1969 185 p refs Prepared by the Geol. Surv. in cooperation with Calif. Univ., Los Angeles. Dept. of Geography Original contains color illustrations rept. based on Robert H. Mullens, Jr. M.S. Thesis - Calif. Univ., Los Angeles
 (NASA Order W-12570; Contract DI-14-08-0001-10674)
 (NASA-CR-125642; USGS-IR-NASA-153) Avail: NTIS CSCL 08G

Aerial photographs taken with color infrared film were used to differentiate various types of residential areas in the Los Angeles basin, using characteristics of the physical environment which vary from one type of residential area to another. Residential areas of varying quality were classified based on these characteristics. Features of the physical environment, identifiable on CIR aerial photography were examined to determine which of these are the best indicators of quality of residential areas or social areas, as determined by the socioeconomic characteristics of the inhabitants of the selected areas. Association between several physical features and the socioeconomic variables was found to exist. Author

N72-18358* Raytheon Co., Lexington, Mass.
**GEOGRAPHIC ANALYSIS OF MULTIPLE SENSOR DATA
 FROM THE NASA/USGS EARTH RESOURCES PROGRAM**
 Richard F. Pascucci, Gary W. North, Rose Anne Albrizio, and Barry D. Shelkin May 1969 198 p Original contains color illustrations
 (NASA Order W-12589)
 (NASA-CR-125638; USGS-IR-NASA-156) Avail: NTIS CSCL 08G

Qualitative and quantitative analyses were made of multi-sensor data acquired during aircraft missions. While the principal analysis effort was concentrated on imagery taken over test sites in Southern California, data were also studied from records acquired on missions over test sites at Phoenix, Chicago, Asheville, and New Orleans. The objectives of the analyses were: (1) to determine the capabilities of ten remote sensors in identifying the elements of information necessary in conducting geographic investigations in land use analysis, urban problems, surface energy budget, and soil moisture; (2) to determine the feasibility of using these sensors for these purposes at orbital altitudes; and (3) to collate and analyze ground and air data previously collected and assemble it in a format useful in the accomplishment of cost effectiveness studies. Author

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N72-18448* Geological Survey, Washington, D.C.
THE FRAUNHOFER LINE DISCRIMINATOR: AN AIRBORNE FLUOROMETER
 George E. Stoertz 1969 34 p refs
 (NASA Order T-80485-C)
 (NASA-CR-125643; USGS-IR-NASA-157) Avail: NTIS
 CSDL 14B

An experimental Fraunhofer Line Discriminator (FLD) can differentiate and measure solar-stimulated luminescence when viewed against a background of reflected light. Key elements are two extremely sensitive photomultipliers, two glass-spaced Fabry-Perot filters having a bandwidth less than 1 Å, and an analog computer. As in conventional fluorometers, concentration of a fluorescent substance is measured by comparison with standards. Quantitative use is probably accurate only at low altitudes but detection of luminescent substances should be possible from any altitude. Applications of the present FLD include remote sensing of fluorescent dyes used in studies of current dynamics. The basic technique is applicable to detection of oil spills, monitoring of pollutants, and sensing over land areas. Author

N72-18451* Geological Survey, Washington, D.C.
FRAUNHOFER LINE-DEPT SENSING APPLIED TO WATER
 George E. Stoertz 1969 51 p refs
 (NASA Order T-80485-C)
 (NASA-CR-125654; USGS-IR-NASA-158) Avail: NTIS
 CSDL 14B

An experimental Fraunhofer line discriminator is basically an airborne fluorometer, capable of quantitatively measuring the concentration of fluorescent substances dissolved in water. It must be calibrated against standards and supplemented by ground-truth data on turbidity and on approximate vertical distribution of the fluorescent substance. Quantitative use requires that it be known in advance what substance is the source of the luminescence emission; qualitative sensing, or detection of luminescence is also possible. The two approaches are fundamentally different, having different purposes, different applications, and different instruments. When used for sensing of Rhodamine WT dye in coastal waters and estuaries, the FLD is sensing in the spectral region permitting nearly maximum depth of light penetration. Author

N72-19357* National Center for Atmospheric Research, Boulder, Colo.
PARTICULATE MODELS: THEIR VALIDITY AND APPLICATION
 I. H. Blifford, Jr., ed. Aug. 1971 290 p refs Workshop held at Boulder, Colo., 21 Aug. 1970 Sponsored by NSF
 (NCAR-TN/PROC-68) Avail: NTIS

The aim of formulating more realistic models of atmospheric particulates is pursued by studying various aerosol measurement techniques, the formations of theoretical aerosol and hydrometeor models, and by analyzing the optical properties of upper and lower atmospheric aerosols. The emphasis is on air pollution.

N72-19367* Colorado State Univ., Fort Collins.
SLANT PATH RADIATION THROUGH HAZE LAYERS
 William E. Marlatt /in NCAR Particulate Models: Their Validity and Appl. Aug. 1971 p 93-104
 Avail: NTIS

To determine radiative transfer through haze layers, a series of profile measurements were made by aircraft instrumented with a spectrometer, aerosol and nucleus counters, upward- and downward-viewing pyranometers, tracking camera, downward viewing 8 to 12 micron radiometer, and a MRIR radiometer mounted to view upward for horizon to horizon scanning. Angular distributions for two wavelength ranges over Colorado and over Houston revealed that the total accumulation of particles in a column of 1 sq ft extending from the surface to 16,000 ft over Houston is nearly 150 times that over eastern Colorado. Attenuation of sky radiation as a function of slant path is determined by comparison of MRIR measurements above and below the haze layer with those calculated by the Cox-Kuhn computer model for radiation transfer. G.G.

N72-19454* Kansas Univ./Center for Research, Inc., Lawrence Remote Sensing Lab.
THE DISCRIMINATION OF TROPICAL LAND USE IN PUERTO RICO: AN ANALYSIS USING MULTISPECTRAL IMAGERY
 Roland D. Mower Oct. 1971 240 p refs
 (Contracts DAAK02-68-C-0089; DI-14-18-0001-12077; DA Proj. 4A0-81102-B-81-E)
 (AD-733472; CRINC-TR-133-25; ETL-CR-71-20) Avail: NTIS
 CSDL 13/2

During the past decade, the technique of remote sensing has received considerable attention within the scientific community and outside of it as well. Many practical applications of remote sensing have been developed, and a great deal of research is now in progress. It seems appropriate that geographers should be actively engaged in the development and refinement of remote sensing techniques - techniques that must be designed by geographers if they are to be utilized as tools for geographic research. At the present time, remote sensing does not represent a new information system, complete with hardware, software and know-how, capable of providing all of the data that geographers previously listed under the heading 'POTENTIAL USES OF REMOTE SENSING IN GEOGRAPHY.' Although remote sensing has not yet reached the level of capability predicted for it by early enthusiasts, it has shown considerable promise. This study is just one of many that was conceived and designed to bridge the gap between abstract theoretical concepts on one hand and user oriented products on the other.

Author (GRA)

N72-20353* Geological Survey, Washington, D.C. Geographical Applications Program.
PROPOSED EXPERIMENTAL PROGRAMS FOR TESTING REMOTE SENSOR APPLICATIONS IN THE METROPOLITAN WASHINGTON AREA Final Report
 Harry J. Mallon and Joan Y. Howard Feb. 1972 21 p refs
 (NASA Order W-13318; Contract DI-14-08-0001-12708)
 (NASA-CR-125825; TR-7; USGS-IR-NASA-221) Avail: NTIS
 CSDL 08G

A group of suggested experiments is described, which are to be conducted with ERTS-A and high altitude aircraft imagery during the 1972 period. Methods of analysis and observation of land use, urban change, transportation, and possible pollution, using small scale, low resolution data, are discussed. Author

N72-20479* Toronto Univ. (Ontario). Inst. for Aerospace Studies.
THE DEVELOPMENT OF AN AIRBORNE REMOTE LASER FLUOROSENSOR FOR USE IN OIL POLLUTION DETECTION AND HYDROLOGIC STUDIES
 R. M. Measures and M. Bristow Dec. 1971 36 p refs
 Sponsored by Dept. of Energy, Mines, and Resources
 (UTIAS-175) Avail: NTIS

The first phase of a development program devoted to the exploitation of laser induced fluorescence for environmental sensing has been completed. A prototype laser fluorosensor has been constructed and used to evaluate, in the laboratory, the feasibility of this concept and to explore the potential range of applications. Special attention has been given to assessing the ability of a laser fluorosensor to map the extent of an oil slick, locate the source of lignin sulphonate pollution and monitor the dispersal of a tracer dye for hydrologic uses. The preliminary results are very encouraging and lead to prediction that a laser fluorosensor could be used for environmental sensing from an aircraft flying at between 1000 and 2000 ft on a 24-hour basis.

Author

N72-22384* Metropolitan Washington Council of Governments, D.C.
AN EXAMINATION OF APPLICATIONS OF REMOTE SENSING DATA TO METROPOLITAN WASHINGTON COUNCIL OF GOVERNMENTS' PLANNING REQUIREMENTS

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Harry J. Mallon, Joan Y. Howard, and Kenneth M. Karch Dec. 1971 65 p refs
(NASA Order W-13318; DI-14-08-0001-12708)
(NASA-CR-126309; USGS-IR-NASA-224; USGS-DO-72-00)
Avail: NTIS CSDL 08G

A comprehensive inventory of a series of remote sensing applications for a variety of regional planning programs in metropolitan Washington was undertaken. Examples of application, methods for data utilization, and corresponding photographic illustrations are provided illustrating how remote sensing would prove particularly useful as a unique and/or supplemental data source. Author

N72-22369* Kansas Univ., Lawrence. Dept. of Geography. **ENVIRONMENT MAPPING WITH SPACECRAFT PHOTOGRAPHY: A CENTRAL AUSTRALIAN EXAMPLE** David S. Simonett, G. Ross Cochrane, Stanley A. Morain, and Dwight E. Egbert Jun. 1969 51 p
(NASA Order W-12570; Contract DI-14-08-0001-10848)
(NASA-CR-126133; USGS-IR-NASA-172) Avail: NTIS CSDL 08B

Boundary delineation from space photographs as a precursor to area typing was studied for characterization of land use and resource mapping near Alice Springs, Australia, where both boundary detection and categorization are complicated by the variations of the landscape. The detection and meaning of boundaries, and sources of confusion during categorization are discussed. F.O.S.

N72-22471* California Univ., Livermore. Lawrence Livermore Lab. **EXPERIENCE IN THE USE OF AN ANTICOINCIDENCE SHIELDED Ge(Li) GAMMA RAY SPECTROMETER FOR LOW LEVEL ENVIRONMENTAL RADIONUCLIDE ANALYSIS** P. L. Phelps and K. O. Hamby 25 Oct. 1971 28 p refs
Presented at the Nuc. Sci. Symp., San Francisco, 3-5 Nov. 1971 (UCRL-73521; Conf-711111-18) Avail: NTIS

An evaluation of a low level, high resolution anticoincidence shielded Ge(Li) spectrometer, constructed over five years ago, was made. The evaluation was based upon results obtained in assaying a variety of biological and environmental samples, each contained in a 200 cm³ aluminum can. The spectrometer used an 18 cm³ planar type Ge(Li) detector. An example of the very high sensitivity possible with the spectrometer was in the assaying for Cs-137 in a 296 gram soil sample which was determined to have a concentration of 0.027 pCi of Cs-137 per gram of soil. Description of the spectrometer, methods used in data analysis and results of counting low level samples are given. Author (NSA)

N72-22988* Mitre Corp., McLean, Va. **MONITORING THE ENVIRONMENT OF THE NATION Final Report** C. A. Bisselle, M. C. Fowler, S. N. Goldstein, R. S. Greeley, M. J. Lilienthal, R. P. Pikul, D. M. Rosenbaum, W. D. Rowe, and D. B. Walker Apr. 1971 216 p
(Contract C-CEQ-3-71)
(PB-205989; MTR-1660) Avail: NTIS CSDL 13B

The system describes approximately 110 environmental indices and indicators and major data gaps are identified in current monitoring programs which must be reduced to allow for routine computation of the indices. The system concept features maximal exploitation of existing monitoring resources for collection of environmental data. An analysis of alternatives for computing environmental indices has identified advantages and disadvantages of centralized versus decentralized processing configurations. An implementation plan is presented to achieve an initial operating capability without requiring a selection of the final processing configuration at this time. Author (GRA)

N72-23653* National Oceanic and Atmospheric Administration, Boulder, Colo. **REMOTE SENSING OF POLLUTANTS Annual Report** 30 Jun. 1971 52 p
(PB-206734; APTD-0891) Avail: NTIS HC \$3.00 CSDL 07D

Research results obtained during FY 71 are summarized: on quantitative infrared spectra of pollutant gases such as CO, O₃, HC1, SO₂, NH₃, and HNO₃; on analyzing long path infrared spectra by digital means for atmospheric gas concentrations; on scattering cross section measurements for SO₂ and NO; and on literature search and consultative services in atmospheric spectroscopy. Explanations and reviews of the particular results are illustrated by samples of the voluminous transmission tables and graphs supplied separately. The developed information is crucial for proper interpretation of remote sensing field measurements of pollutant concentrations in both source and ambient situations. Author (GRA)

N72-24399* Wisconsin Univ., Madison. **MONITORING WATER POLLUTION BY MEANS OF REMOTE SENSING TECHNIQUES** James P. Scherz Apr. 1971 39 p refs
(Grant NGL-50-002-127)
(NASA-CR-126640; Rept-3) Copyright. Avail: Wis. Univ., Madison, 351 Meteorology and Space Sci. Bldg.: HC \$2.00 CSDL 08H

The use of airborne remote sensors for observing water pollution is discussed. The advantages of remote sensing imaging are considered. Methods of correlating thermal imagery with water conditions are presented. K.P.D.

N72-24401* Wisconsin Univ., Madison. Dept. of Civil Engineering. **AN INTRODUCTION TO REMOTE SENSING FOR ENVIRONMENTAL MONITORING** James P. Scherz, Alan R. Stevens, and Edmund R. Belak, Jr., ed. Apr. 1970 83 p refs
(Grant NGL-50-002-127)
(NASA-CR-126630; Rept-1) Copyright. Avail: Wis. Univ., Madison, 351 Meteorology and Space Sci. Bldg.: HC \$2.00 CSDL 08D

An overall view is given of the electromagnetic energy spectrum. Remote sensing instruments are described that have potential use from either aircraft or satellites. Emphasis is on photographic, thermal imagery, side-looking radar, and passive microwave systems. Five basic areas are covered: (1) theory of the electromagnetic spectrum; (2) hardware presently used in remote sensing; (3) present and future applications of remote sensing; and (4) library sources for remote sensing material. Author

N72-24402* Wisconsin Univ., Madison. **DETERMINATION OF OIL FILM DEPTHS FOR WATER POLLUTION CONTROL** John F. VanDomelen and Edmund R. Belak, Jr., ed. Jun. 1971 20 p refs
(Grant NGL-50-002-127)
(NASA-CR-126634; Rept-4) Copyright. Avail: Wis. Univ., Madison, 351 Meteorology and Space Sci. Bldg.: HC \$2.00 CSDL 08J

Research was initiated to determine if a reasonably inexpensive, easy to use system could be developed with off-the-shelf components to detect the thickness of an oil spill. Because of the high costs involved in obtaining the equipment and the complexity involved in operating it, procedures explored the use of color and color infrared photography with or without the use of polarizing filters. Color reversal films for use in a 35 mm. three camera bank were selected. Color reversal film was selected because of the ease of repeatability and reliability of color results and the relatively low cost of the final product. Field procedures, image analysis using spectrophotometer and microdensitometer, and results of experiments conducted on bright and cloudy days are described. Tests revealed that there is a correlation between the depth of the oil spill and the percentage of light reflected. Author

N72-24403* Wisconsin Univ., Madison. Dept. of Civil Engineering. **A LITERATURE REVIEW OF REMOTE SENSING FOR WATER QUALITY** Lorne C. Gramms, William C. Boyle, and Edmund R. Belak, Jr., ed. Oct. 1971 35 p refs

02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

(Grant NGL-50-002-127)

(NASA-CR-126638; Rept-7) Copyright. Avail: Wis Univ., Madison, 351 Meteorology and Space Sci. Bldg.: HC \$2.00 CSCI 08H

Remote aerial sensing techniques were employed to observe the following water quality criteria: grease and floating solids, nonbiological turbidity, color, and temperature. Some secondary effects that are associated with above parameters, like dissolved oxygen and algal growth potential, were also determined. Multispectral photographic methods consisted of color photography, infrared photography, black and white photography, thermal radiation, and selective wavelength filters. G.G.

N72-24409*# Florida Atlantic Univ., Boca Raton. Dept. of Geography.

SIMULATING AND INTERPRETING AERIAL OR ORBITAL TV OBSERVATIONS OF GEOGRAPHIC PATTERNS Final Report

James P. Latham Jan. 1972 118 p refs

(NASA Order R-09-020-024(A-1); NASA Order W-12570; Contract DI-14-08-0001-10936)

(NASA-CR-126254; USGS-DO-72-004; USGS-IR-NASA-223; TR-5) Avail: NTIS HC \$8.00 CSCI 08F

Methods, techniques, instrumentation systems, and concepts or analyses developed by an investigation of the possibilities, problems, and applications of interpreting the geographic patterns recorded by orbital television observations of earth resources and land use are presented. A system of simulating orbital TV imagery by scanning astronaut-acquired photography and converting it to a TV monitor image was developed. Study of this TV imagery determined the feasibility for extracting and mapping geographic data and analyzed how the capability varied with changes in scan line intensity or image scale. Other studies established the feasibility of directly processing TV signals with a waveform and computer analysis technique that produces a printout category map of land use types, the use of waveform signal analysis to quantify the geographic patterns and identify phenomena recorded in color and color infrared aerial imagery, and the use of high altitude aerial photography to make a geographic region analysis or locate pollution. For individual titles, see N72-24410 through N72-24414.

N72-24410*# Florida Atlantic Univ., Boca Raton.

A SYSTEM FOR SIMULATING AERIAL OR ORBITAL TV OBSERVATIONS OF GEOGRAPHIC PATTERNS

James P. Latham. In *its* Simulating and Interpreting Aerial or Orbital TV Observations of Geographic Patterns Jan. 1972 p 7-34

Avail: NTIS HC \$8.00 CSCI 08F

A system which simulates observation of the earth surface by aerial or orbiting television devices has been developed. By projecting color slides of photographs taken by aircraft and orbiting sensors upon a rear screen system, and altering scale of projected image, screen position, or TV camera position, it is possible to simulate alternatives of altitude, or optical systems. By altering scan line patterns in COMU 3200 series camera from 525 to 945 scan lines, it is possible to study implications of scan line resolution upon the detection and analysis of geographic patterns observed by orbiting TV systems. Author

N72-24411*# Florida Atlantic Univ., Boca Raton.

INTERPRETATION OF GEOGRAPHIC PATTERNS IN SIMULATED ORBITAL TELEVISION IMAGERY OF EARTH RESOURCES

James P. Latham, Clark I. Cross, William H. Kuyper, and Richard E. Witmer. In *its* Simulating and Interpreting Aerial or Orbital TV Observations of Geographic Patterns Jan. 1972 p 35-84

Avail: NTIS HC \$8.00 CSCI 08F

In order to better determine the effects of the television imagery characteristics upon the interpretation of geographic patterns obtainable from orbital television sensors, and in order to better evaluate the influences of alternative sensor system parameters such as changes in orbital altitudes or scan line

rates, a team of three professional interpreters independently mapped thematically the selected geographic phenomena that they could detect in orbital television imagery produced on a fourteen inch monitor and recorded photographically for analysis. Three thematic maps were compiled by each interpreter. The maps were: (1) transportation patterns; (2) other land use; and (3) physical regions. The results from the three interpreters are compared, agreements noted, and differences analyzed for cause such as disagreement on identification of phenomenon, visual acuity, differences in interpretation techniques, and differing professional backgrounds. Author

N72-24412*# Florida Atlantic Univ., Boca Raton.

COMPUTER LAND USE MAPPING VIA TV WAVEFORM ANALYSIS OF SPACE PHOTOGRAPHY

In *its* Simulating and Interpreting Aerial or Orbital TV Observations of Geographic Patterns Jan. 1972 p 85-89

Avail: NTIS HC \$8.00 CSCI 08B

An instrumentation and computer system which offers the potential for analyzing photogeographic distributions is described. To satisfy the requirement for computer acceptance, a television and waveform system was developed to transpose pictorial or iconic photo forms to the analytic. A video conversion was accomplished, and each pattern visible on the original photography was represented by a certain range of percentages. With spatial occurrences in digital form, a computer program was developed that could identify, analyze, and map geographic inputs. Author

N72-24413*# Florida Atlantic Univ., Boca Raton.

HIGH ALTITUDE COLOR PHOTOGRAPHY AS A TOOL FOR REGIONAL ANALYSIS: AS DEMONSTRATED FOR SOUTHEASTERN FLORIDA

L. Allan Eyre. In *its* Simulating and Interpreting Aerial or Orbital TV Observations of Geographic Patterns Jan. 1972 p 90-99 ref

Avail: NTIS HC \$8.00 CSCI 08G

High altitude color and color infrared photography of the tri-county region of southeast Florida made it feasible to evaluate its potential for quantifying the dimensions of regional change. Attention was focused upon three main aspects of change in the region, which in fact overlap. These were: (1) the transformation of the southeast Florida wetlands; (2) the expansion of agriculture; and (3) the growth of the urbanized area. The development analyzed covered the period of thirteen years from 1956 to 1969. Results using this new 18 km photography were superior because of the degree of resolution, the combined power of color and color infrared interpretation, and the large area covered by each frame. The greatest advantage of high altitude imagery is the time-saving element, since it is possible to delineate and identify major geographic patterns over thousands of sq km very rapidly. Author

N72-24414*# Florida Atlantic Univ., Boca Raton.

REMOTE SENSING OF ENVIRONMENTAL DISTURBANCE

James P. Latham. In *its* Simulating and Interpreting Aerial or Orbital TV Observations of Geographic Patterns Jan. 1972 p 100-103 Presented at Ann. Meeting of Southeast Div., Assoc. of Am. Geographers, Columbia, S. C., 23 Nov. 1970

Avail: NTIS HC \$8.00 CSCI 08F

Color, color infrared, and minus-blue films obtained by RB-57 remote sensing aircraft at an altitude of 60,000 feet over Boca Raton and Southeast Florida Earth Resources Test Site were analyzed for nine different types of photographic images of the geographic patterns of the surface. Results of these analyses are briefly described. Author

N72-24415*# Virginia Univ., Charlottesville. Dept. of Environmental Sciences.

REMOTE SENSING AS A SOURCE OF DATA FOR OUTDOOR RECREATION PLANNING

Wallace E. Reed, H. Grant Goodell, and George D. Emmitt Jan. 1972 210 p refs Sponsored by NASA

02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

(Contract DI-1-14-07-3)
(NASA-CR-126651; USGS-IR-NASA-233) Avail: NTIS HC
\$12.50 CSCL 08B

Specific data needs for outdoor recreation planning and the ability of tested remote sensors to provide sources for these data are examined. Data needs, remote sensor capabilities, availability of imagery, and advantages and problems of incorporating remote sensing data sources into ongoing planning data collection programs are discussed in detail. Examples of the use of imagery to derive data for a range of common planning analyses are provided. A selected bibliography indicates specific uses of data in planning, basic background materials on remote sensing technology, and sources of information on environmental information systems expected to use remote sensing to provide new environmental data of use in outdoor recreation planning.

Author

N72-24421# Colorado Univ., Boulder.
A MODEL FOR PHOTOMORPHIC ANALYSIS TENNESSEE VALLEY TEST SITE

Donald D. MacPhail and Yuk Lee Feb. 1972 36 p refs
(USGS-236) Avail: NTIS HC \$4.00

In order to determine the utility of the photomorphoc concept of landscape analysis to the T.V.A. for use in regional planning, a model for analysis is necessary. The methodology and sampling techniques to be used in conjunction with a demonstration project utilizing the photomorphoc concept include: identifying photomorphoc patterns on black and white, intermediate-scale imagery; reducing these data to base map scale; selecting sample areas; and quantitatively measuring and testing the physical and cultural features such as drainage density, soil moisture, mean farm size, percent of vegetation cover, and population density to determine the validity of the photomorphoc mapping.

Author

N72-24422# Tennessee Univ., Knoxville.
DELINEATION OF INFORMATION REQUIREMENTS OF THE TVA WITH RESPECT TO REMOTE SENSING DATA

John B. Rehder Dec. 1971 22 p refs
(USGS-235) Avail: NTIS HC \$3.25

The information needs and interests of T.V.A. that can be supplied by hyper-altitude imagery and future ERTS-A satellite imagery were determined by interviews. Two series of interviews were used to obtain specific data requirements as they pertain to the kinds of information expected and were particularly keyed to the topics of information needed, the variation of scales and coverage involved between aircraft and satellite platforms, and temporal considerations.

Author

N72-24423# Oklahoma Univ., Norman.
BIBLIOGRAPHY OF REMOTE SENSING APPLICATIONS FOR PLANNING AND ADMINISTRATIVE STUDIES

Nelson R. Nunnally Dec. 1971 75 p refs
(USGS-234) Avail: NTIS HC \$5.75

The annotated bibliography is representative of the material available, both published and unpublished and covers the entire spectrum of application in terms of methodology techniques and procedures, and all types of sensing systems. It is selective in that it attempts to present the best of articles covering the same applications, and to present different viewpoints.

Author

N72-26274*# Johns Hopkins Univ., Baltimore, Md.
INDUSTRIAL WASTE POLLUTION
Loren D. Jensen In NASA, Washington Remote Sensing of the Chesapeake Bay 1972 p 49-58 refs

Avail: NTIS: SOD \$2.25 CSCL 08J

The characteristics and effects of industrial waste pollution in the Chesapeake Bay are discussed. The sources of inorganic and organic pollution entering the bay are described. The four types of pollutants are defined as: (1) inorganic chemical wastes, (2) naturally occurring organic wastes, (3) synthetic organic wastes (exotics) and (4) thermal effluents. The ecological behavior of industrial wastes in the surface waters is analyzed with respect to surface film phenomena, interfacial phenomena, and benthic phenomena

Author

N72-26276*# Virginia Inst. of Marine Science, Gloucester Point.

AGRICULTURAL AND URBAN POLLUTION

Morris L. Brehmer In NASA, Washington Remote Sensing of the Chesapeake Bay 1972 p 73-76
Avail: NTIS: SOD \$2.25 CSCL 04A

The degradation produced by the introduction of agricultural and urban wastes into estuarine systems, with emphasis on the Chesapeake Bay area, is discussed. The subjects presented are: (1) effects of sediment loading and (2) organic and nutrient loading problems. The impact of high turbidity on the biological life of the bay is analyzed. The sources of nutrients which produce over-enrichment of the waters and the subsequent production of phytoplankton are examined.

Author

N72-26277*# Johns Hopkins Univ., Baltimore, Md.
ESTUARINE TURBIDITY, FLUSHING, SALINITY, AND CIRCULATION

Donald W. Pritchard In NASA, Washington Remote Sensing of the Chesapeake Bay 1972 p 77-82
Avail: NTIS: SOD \$2.25 CSCL 08J

The effects of estuarine turbidity, flushing, salinity, and circulation on the ecology of the Chesapeake Bay are discussed. The sources of fresh water, the variations in salinity, and the circulation patterns created by temperature and salinity changes are analyzed. The application of remote sensors for long term observation of water temperatures is described. The sources of sediment and the biological effects resulting from increased sediments and siltation are identified.

Author

N72-26280*# Commission of Outdoor Recreation, Richmond, Va.

RECREATIONAL USES

Elbert Cox In NASA, Washington Remote Sensing of the Chesapeake Bay 1972 p 103
Avail: NTIS: SOD \$2.25 CSCL 08J

The application of remote sensors for management planning of recreational areas in and around the Chesapeake Bay is discussed. The use of infrared photography to examine topography, ground water conditions, biotic life, access to surface water, and surrounding land use is emphasized. It is concluded that the greatest advantage to be obtained from remote sensors is the speed with which the data can be acquired and interpreted to permit timely conservation measures to be taken.

Author

N72-26283*# Geological Survey, Washington, D.C.
PROBLEMS OF URBAN DEVELOPMENT AND GROWTH

Arch C. Gerlach and James R. Wray In NASA, Washington Remote Sensing of the Chesapeake Bay 1972 p 129-138
Original Contains Color Illustrations
Avail: NTIS: SOD \$2.25 CSCL 13B

The increase in the density of human population in urban areas and the effects on various aspects of the environment are discussed. The application of remote sensors to measure, analyze, and predict urban changes and their environmental impact is described. Examples of urban area mapping by aerial photography are included. The methods which have been developed to acquire, analyze, utilize, and preserve remotely sensed data on urban development are presented.

Author

N72-27008* National Aeronautics and Space Administration, Washington, D.C.

ENVIRONMENTAL STATEMENT FOR EARTH RESOURCES AIRCRAFT PROGRAM Draft Environmental Impact Statement

Mar. 1971 6 p
(NASA-TM-X-68550) Avail: NASA Public Document Rooms, \$1.00 CSCL 01B

An environmental impact statement for the Earth Resources Aircraft program is submitted. The program objectives are summarized and the benefits are described. It is concluded that the air pollution resulting from the operation of four aircraft in the program cannot create a significant amount of environmental degradation. The adverse effects which cannot be avoided amount to the operation of the aircraft which meet the established criteria for operational aircraft.

Author

02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

N72-27406# Army Topographic Command, Washington, D.C. AN ANNOTATED BIBLIOGRAPHY OF REMOTE SENSING OF AIR AND WATER POLLUTION

Paul Dennis Brooks and George W. Thomson Sep. 1971 26 p
refs

(AD-737588) Avail: NTIS CSCL 13/2

The annotated bibliography represents an attempt to compile a complete list of literature published between 1965 - 1970 on the subject of remote sensing of air and water pollution. The general types covered include: Airborne and spacecraft surveillance; photogrammetric lidar nephelometers; non-dispersive infrared optical interferometer; aerial panchromatic photography; aerial infrared imagery; radiophase; and earth resistivity measurements. GRA

N72-27422*# Kansas Univ., Lawrence. ON THE USE OF SPACE PHOTOGRAPHY FOR IDENTIFY- ING TRANSPORTATION ROUTES: A SUMMARY OF PROBLEMS

David S. Simonett, Floyd M. Henderson, and Dwight D. Egbert
Jan. 1970 25 p Prepared for Geological Survey, Washington,
D. C.

(NASA Order W-12570; Contract USGS-14-08-0001-10848)

(NASA-CR-127530; USGS-IR-NASA-171) Avail: NTIS HC
\$3.00 CSCL 14E

It has been widely suggested that space photography may be used for updating maps of transportation networks. Proponents of the argument have suggested that color space photographs of the resolution obtained with Hasselblad 80 mm lenses (about 300 feet) contain enough useful information to update the extensions of major U. S. highways. The present study systematically documents for the Dallas-Fort Worth area the potential of such space photography in detecting, and to a lesser degree identifying, the existing road networks. Color separation plates and an enlargement of the color photograph were produced and all visible roads traced onto transparencies for study. Major roads and roads under construction were the most visible while lower class roads and roads in urban areas had the poorest return. Road width and classification were found to be the major determinant in visibility, varying from 100 per cent visible for divided highways to 15 per cent visible of bladed earth roads. In summary, space photographs of this resolution proved to be difficult to use for accurate road delineation. Only super highways in rural areas with the greatest road-width were completely identifiable, the width being about 1/3 that of the resolution cell. Author

N72-27908* National Aeronautics and Space Administration, Washington, D.C.

ENVIRONMENTAL STATEMENT FOR EARTH RESOURCES TECHNOLOGY SATELLITE PROGRAM Draft Environmental Impact Statement

Mar. 1971 6 p

(NASA-TM-X-68552) Avail: NASA Public Document Rooms,
\$1.00 CSCL 22B

An environmental impact statement for the Earth Resources Technology Satellite program is presented. The mission of the ERTS-A and ERTS-B satellites is described. The methods for acquiring new and extensive data directly relating to conservation of the environment are described. It is concluded that no depletion of natural resources will result from the ERTS program. Author

N72-28151# Kentucky Univ., Lexington. Water Resource Inst. DETECTION AND IDENTIFICATION OF MOLECULAR WATER POLLUTANTS BY LASER RAMAN SPECTROSCOPY Final Report, Sep. 1968 - Aug. 1971

Eugene B. Bradley, Charles A. Frenzel, John Reeves, Robert
McConnell, and Kay Lane Oct. 1971 48 p refs
(Contract DI-14-31-0001-3217)

(PB-208029; RR-44) Avail: NTIS HC \$3.00 CSCL 07D

Laser Raman spectroscopy is evolving into a primary tool for the identification of molecular water pollutants. The study approaches the limits of detectivity of carbon disulfide and benzene to about 20 ppm in water solutions using a high-resolution Raman spectrometer, cooled detectors, and photon counting techniques. An optimized design for a pollution

measuring instrument is suggested, and a prototype has been built which is useful with any value of excitation energy short of sample degrading. The present instrument scans spectrum windows with fixed preselecting filters followed by a small single monochromator with high throughput. The resulting detectivity with 20 mw of laser power was only 1000 ppm. Author (GRA)

N72-28215# Army Chemical Center, Edgewood, Md. PROCEEDINGS OF MEETING ON ENVIRONMENTAL POLLUTION (1ST)

Elmer Engquist, comp. Feb. 1972 96 p Meeting held at
Edgewood Arsenal, Md., 15-16 Apr. 1970; sponsored by Am.
Ordnance Assoc.

(AD-738544; EA-SP-100-78) Avail: NTIS CSCL 13/2

The report contains the papers presented at Edgewood Arsenal on 15 and 16 April 1970 at the First Meeting on Environmental Pollution sponsored by the American Ordnance Association. The papers were presented by representatives of Department of Defense, industry, and predecessor organizations of the Environmental Protection Agency (National Air Pollution Control Administration, Bureau of Solid Waste Management, and Federal Water Pollution Control Administration). Topics include solid and liquid waste disposal, water and air pollution control, and air monitoring techniques. Author (GRA)

N72-28310*# Maine Dept. of Transportation, Augusta. DETECTION AND MONITORING VEGETATION DAMAGE ASSOCIATED WITH HIGHWAYS AND HIGHWAY FACILITIES Progress Report

Ernest G. Stoeckeler, principal investigator 1 Jul. 1972 2 p
(Contract NAS5-21724)

(E72-10002; NASA-CR-127557; GSFC-ID-ST350) Avail: NTIS
HC \$3.00 CSCL 08M

Author

N72-28315*# Purdue Univ., Lafayette, Ind. Lab. for Application of Remote Sensing.

A LAND USE CLASSIFICATION OF THE TEXOMA FRAME (AN APPROXIMATELY SQUARE AREA OF 100 NAUTICAL MILES BOUNDARY, CENTERED ON A POINT 15 MILES SOUTH-EAST OF DURANT, OKLAHOMA AND AP- PROXIMATELY 5 MILES NORTH OF THE RED RIVER) AND OF TWO SUB FRAMES OF THIS ENTIRE FRAME

D. A. Landgrebe, principal investigator 15 Aug. 1972 4 p
Sponsored by NASA

(E72-10009; NASA-CR-127475; GSFC-ID-UN103;

ERTS-A-Proposal-SR-040) Avail: NTIS HC \$4.00 CSCL 08H
Author

N72-28316*# Dartmouth Coll., Hanover, N.H. Dept. of Geography.

LAND USE IN NORTHERN MEGALOPOLIS Progress Report

Robert B. Simpson, principal investigator 31 Jul. 1972 1 p
(Contract NAS5-21749)

(E72-10010; NASA-CR-127615; GSFC-ID-101; PR-1) Avail:
NTIS HC \$3.00 CSCL 08B

Author

N72-28317*# Maine Dept. of Transportation, Augusta. TO DEVELOP A LAND USE PEAK RUNOFF CLASSIFICA- TION SYSTEM FOR HIGHWAY ENGINEERING PURPOSES Progress Report

E. G. Stoeckeler, principal investigator 1 Aug. 1972 1 p

(Contract NAS5-21772)

(E72-10011; NASA-CR-127617; GSF-ID-203(ST354)) Avail:
NTIS HC \$3.00 CSCL 08B

Author

N72-28346*# Metropolitan Washington Council of Governments, D.C.

REMOTE SENSING PROJECT Final Report

Harry J. Mallon and Joan Y. Howard Feb. 1972 29 p

02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

(NASA Order W-13318; Contract DI-14-08-0001-12708)
(NASA-CR-127474; TR-8; USGS-IR-NASA-226) Avail: NTIS
HC \$3.50 CSCL 08G

The accomplishments and publications developed during the study are summarized. They illustrated a series of practical applications of remote sensing data to the urban-regional planning processes in the metropolitan Washington area. Author

N72-28348* Metropolitan Washington Council of Governments, D.C.

BENEFITS FROM REMOTE SENSING DATA UTILIZATION IN URBAN PLANNING PROCESSES AND SYSTEM RECOMMENDATIONS

Harry J. Mallon and Joan Y. Howard Jan. 1972 49 p refs
(NASA Order W-13318; Contract DI-14-08-0001-12708)
(NASA-CR-127476; TR-6; USGS-IR-NASA-227) Avail: NTIS
HC \$4.50 CSCL 08G

The benefits of utilizing remote sensor data in the urban planning process of the Metropolitan Washington Council of Governments are investigated. An evaluation of sensor requirements, a description/ comparison of costs, benefits, levels of accuracy, ease of attainment, and frequency of update possible using sensor versus traditional data acquisition techniques are discussed. Author

N72-28385 Centre National d'Etudes Spatiales, Montpellier (France). Centre d'Etudes Phytosociologiques et Ecologiques.
IS REMOTE SENSING OF NATURAL AND ARTIFICIAL ECOSYSTEMS JUSTIFIED AND POSSIBLE? [LA TELEDETECTION DES ECOSYSTEMES NATURELS ET ARTIFICIELS EST-ELLE JUSTIFIEE ET POSSIBLE?]

G. Long, G. Rimbault, and J.-L. Guillermin In CNES Remote Sensing of Earth Resources Oct. 1971 p 95-123 In FRENCH Original contains color illustrations

An approach to the study of the biosphere is proposed that gives priority to investigations of the autotrophic vegetation, the first link in the food chain. It is shown that an ecological study in depth of the vegetation may explain the mechanisms that have led to the present humanized landscape of the vegetation cover in Europe. ESRO

N72-28386 Bureau pour le Developpement de la Production Agricole, Paris (France).

CONTRIBUTION OF AIRBORNE INFORMATION TO THE TECHNIQUES OF RURAL PLANNING: RESULTS OF 1970-1971 WORK [CONTRIBUTION DE L'INFORMATION AEROPORTEE DANS LE CADRE DES TECHNIQUES D'AMENAGEMENT DE L'ESPACE RURAL: RESULTATS DES TRAVAUX 1970-71]

Pierre Leroux In CNES Remote Sensing of Earth Resources Oct. 1971 p 124-138 In FRENCH Original contains color illustrations

An approach to the analysis of Cernay-la-Ville and Bricy Arthenay terrains by means of remote sensing is proposed, and results of different airborne techniques discussed. They include photographic recording, using four different emulsions, and thermal recordings. Advantages of using infrared photography are shown. The optima periods for remote sensing are chosen. Results obtained from stratospheric balloon recordings are discussed. ESRO

N72-28424* Defense Documentation Center, Alexandria, Va.
OIL SLICKS AND FILMS Report Bibliography, Sep. 1961 - Mar. 1971

Mar. 1972 70 p refs
(AD-738500; DDC-TAS-71-64) Avail: NTIS CSCL 13/2

References pertaining to the cleaning and removal of oil slicks, oil films, and related films from sea surfaces, or water surfaces have been compiled in the bibliography. Included are Corporate Author-Monitoring Agency, Subject, Title, and Personal Author Indexes. Author (GRA)

N72-28524* Toronto Univ. (Ontario). Inst. for Aerospace Studies.

A COMPARATIVE STUDY OF LASER METHODS OF AIR POLLUTION MAPPING

R. M. Measures Dec. 1971 47 p refs
(UTIAS-174) Avail: NTIS HC \$4.50

A comparative study was made of three laser methods of remotely mapping gaseous pollutants in the atmosphere. It was found that, in the case of NO₂ and SO₂, differential absorption and scattering have superior performance potential with regard to range and sensitivity than either laser-induced fluorescence or Raman backscattering. An analysis of the fluorescence return expected from a local source of NO₂ indicated that a plume of about 10 ppm could be detected at a range of several kilometers. Author

N72-29273* State of Ohio Dept. of Development, Columbus.
RELEVANCE OF ERTS TO THE STATE OF OHIO Progress Report, Jul. 1972

David C. Sweet, Principal Investigator Jul. 1972 3 p Prepared in part by Battelle Mem. Inst., Columbus, Ohio
(Contracts NAS5-21782; BCL-72-17/G-1793)
(E72-10021; NASA-CR-127745) Avail: NTIS HC \$3.00 CSCL 08G

N72-29299* Barringer Research Ltd., Rexdale (Ontario).
EXPERIMENTAL RESULTS IN THE REMOTE SENSING OF GASES FROM HIGH ALTITUDES

A. R. Barringer and J. H. Davies [1972] 32 p
(Rept-1001244) Avail: NTIS HC \$3.75

A brief history of correlation spectroscopy is provided. The continuing progress made in the experimental and theoretical development of techniques for remote sensing of trace gases by optical correlation methods is reviewed. The concept of correlation spectrometry has been improved by the use of computer techniques for correlation mask optimization, and the problems of atmospheric scattering have been investigated in some detail. Good results have been obtained in terms of monitoring patterns of pollution and tracking plumes, and methods are being developed for improving the absolute accuracy of measurements. Prospects are reviewed for the ultimate development of scanning multigas monitors for satellite platforms and their potential role in measuring the buildup of atmospheric pollution on a worldwide scale. Experiments are also described which relate to the feasibility of remote gas detection in trace amounts as an aid to natural resources exploration and survey. Author

N72-29315* National Aeronautics and Space Administration, Mississippi Test Facility, Bay Saint Louis.

SUMMARY OF 1971 LAND REMOTE SENSING INVESTIGATIONS

Darden Wayne Mooneyhan In its 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 35 p Original contains color illustrations
CSCL 08G

Techniques to provide land use up-date information using remotely sensed data and automatic data processing technology are being developed. The approach utilizes multispectral scanners, the associated data analysis station, and the pattern recognition programs to identify and classify land surface characteristics, including wetlands, and to convert these data to demonstration type experiments in the various disciplines. Author

N72-29318* National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

ENVIRONMENTAL APPLICATIONS ACTIVITY AT MARSHALL SPACE FLIGHT CENTER

c14
Charles T. N. Paludan In its 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 12 p ref

CSCL 14B

02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

MSFC environmental applications demonstration projects have emphasized application of aerospace technology to community needs of southeastern U.S. Some of the typical projects underway are: hydrological parameter determination; land use surveys; agricultural stress detection; new community site surveys; pollution monitoring; urban transportation studies; and urban environmental quality. Author

N72-29322* National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.

PUBLIC HEALTH APPLICATIONS OF REMOTE SENSING

c04

Charles E. Fuller *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 20 p Original contains color illustrations

CSSL 06C

Remote infrared and multispectral photography were used to identify coastal salt water-fresh water interfaces conducive to encephalitis vector mosquito breeding in Florida, and to determine the environmental conditions that caused an explosive outbreak of anthrax in Louisiana. Multiband photographic inventories were obtained by simultaneously processing three photographic negatives of the same view which record different wavelength portions of the same light. The process enhances differentiation of vegetative communities and sharply delineates edge effects by assigning false colors to differentiate subtle density differences. G.G.

N72-29326* Lockheed Electronics Co., Houston, Tex.

DETECTION OF OIL SPILLS USING 13.3 GHz RADAR SCATTEROMETER

K. Krishen *In NASA, Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 27 p refs* Original contains color illustrations

CSSL 17I

N72-29362* Bureau of Land Management, Washington, D.C. **REMOTE SENSING ON INDIAN AND PUBLIC LANDS**

Grover B. Torbert and Arthur M. Woll (Bur. of Indian Affairs, Washington, D. C.) *In NASA, Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 7 p*

CSSL 08G

The use of remote sensing techniques by the Bureau of Indian Affairs and Land Management in planning resource problems, making decisions, writing environmental impact statements, and monitoring their respective programs is investigated. For Indian affairs, data cover the Papago, Fort Apache, San Carlos, and South Dakota Reservations. For the Land Management Office, data cover cadastral surveys, California desert study, range watersheds, and efforts to establish a natural resources information system. E.H.W.

N72-29363* Bureau of Mines, Pittsburgh, Pa.

THE REMOTE SENSING OF AIR POLLUTION FROM COAL UTILIZATION

c20

Brian M. Harney, Donald H. McCrea, and Albert J. Forney *In NASA, Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 14 p refs* Original contains color illustrations

CSSL 04B

An investigation was made to determine the feasibility of applying earth resources data to the detection of air pollution, particularly pollution from coal burning. Efforts were also made to detect any damage caused by such pollution to vegetation growth and tree life. Results show that vegetative vigor even at low ambient concentrations was damaged and that Eastern white pine trees were severely damaged by the pollutants. Author

N72-29368* Geological Survey, Washington, D.C.

THE GEOGRAPHY AND HUMAN CULTURAL RESOURCES WORKING GROUP OF THE EROS PROGRAM

Arch C. Gerlach *In NASA, Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 4 p*

CSSL 08F

The functions, activities, and objectives of the Geography and Human-Cultural Resources Working Group of the EROS program are outlined. The Group's primary function is to coordinate remote sensing experiments of physical scientists and the needs of socioeconomic and culturally orientated planners, policy makers, administrators, and other user groups. Other functions of the Group include land use analysis, resource mapping, and development of an operational automatic information system receptive to land use and environmental data. E.H.W.

N72-29369* Geological Survey, Washington, D.C. Geographic Applications Program.

AN AUTOMATED MAP AND MODEL OF LAND USE IN THE PHOENIX QUADRANGLE

John L. Place *In NASA, Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 19 p*

CSSL 08B

Efforts to develop an automated system, from ERTS data, for producing computer models and computer maps of land use and other environmental factors for the Phoenix quadrangle are outlined. E.H.W.

N72-29370* Geological Survey, Washington, D.C. Geographic Applications Program.

CENTRAL ATLANTIC REGIONAL ECOLOGICAL TEST SITE

Robert H. Alexander *In NASA, Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 23 p refs* Original contains color illustrations

CSSL 08G

The work of the Central Atlantic Regional Ecological Test Site (CARETS) project is discussed. The primary aim of CARETS is to test the hypothesis that data from ERTS-A can be made an integral part of a regional land resources information system, encompassing both inventory of the resource base and monitoring of changes, along with their effects on the quality of the environment. Another objective of the project is to determine scaling factors for developing land use information and regional analysis for regions of any given size. Author

N72-29371* Geological Survey, Washington, D.C. Geographic Applications Program.

THE CENSUS CITIES PROJECT: A STATUS REPORT FOR 1971

c14

James R. Wray *In NASA, Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 21 p* Original contains color illustrations

CSSL 14E

Work done by the Census Cities Project during 1971 is outlined. The project is designed to detect urban changes in land resource utilization from remote high altitude aircraft and earth orbiting satellite sensors, aid metropolitan regional planners, and provide urban land use maps for various areas. Land use maps are given of several areas observed during 1971. E.H.W.

N72-29372* Geological Survey, Washington, D.C. Geographic Applications Program.

BUREAU AND AGENCY REPORTS

George L. Loelkes *In NASA, Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 12 p*

CSSL 08F

A summary of the work done by Geography and Human-Cultural Resources Work Group on EROS resources management program is given. Work covers archeological surveys, outdoor recreational planning, and engineering studies. E.H.W.

02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

N72-29374* Geological Survey, Tampa, Fla. DISCRIMINATION OF FLUORIDE AND PHOSPHATE CONTAMINATION IN CENTRAL FLORIDA FOR ANALYSES OF ENVIRONMENTAL EFFECTS

A. E. Coker, R. Marshall, and F. Thomson (Michigan Univ., Ann Arbor) *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 12 p Original contains color illustrations

CSCL 08H

A study was made of the spatial registration of fluoride and phosphate pollution parameters in central Florida by utilizing remote sensing techniques. Multispectral remote sensing data were collected over the area and processed to produce multispectral recognition maps. These processed data were used to map land areas and waters containing concentrations of fluoride and phosphate. Maps showing distribution of affected and unaffected vegetation were produced. In addition, the multispectral data were processed by single band radiometric slicing to produce radiometric maps used to delineate areas of high ultraviolet radiance, which indicates high fluoride concentrations. The multispectral parameter maps and radiometric maps in combination showed distinctive patterns, which are correlated with areas known to be affected by fluoride and phosphate contamination. These remote sensing techniques have the potential for regional use to assess the environmental impact of fluoride and phosphate wastes in central Florida. Author

N72-29375* Geological Survey, Denver, Colo. Water Resources Div. APPLICATIONS OF SPECTROSCOPY TO REMOTE DETERMINATION OF WATER QUALITY

Marvin C. Goldberg and Eugene R. Weiner (Denver Univ., Colo.) *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 14 p refs

CSCL 08H

The use of remote laser Raman and molecular spectroscopic techniques to measure water quality is examined. Measurements cover biological, chemical, and physical properties of the water. Experimental results show chemical properties are harder to obtain remotely than biological or physical properties and that molecular spectroscopy seems to be the best method for obtaining water quality data. E.H.W.

N72-29376* Missouri Univ., Kansas City. Dept. of Physics. SPECTRAL REFLECTANCE OF SELECTED AQUEOUS SOLUTIONS FOR WATER QUALITY APPLICATIONS

M. R. Querr, R. C. Waring, W. E. Holland, W. Nijm, and G. M. Hale *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 17 p refs

(Contract DI-14-08-0001-12636)

CSCL 08H

The relative specular reflectances of individual aqueous solutions having a particular chemical salt content were measured in the 2 to 20 micrometers region of the infrared component of radiant flux. Distilled water was the reflectance standard. The angle of incidence was 70.03 deg plus or minus 0.23 deg. Absolute reflectances of the solutions for the same polarization and angle of incidence were computed by use of the measured relative reflectances, one of the Fresnel equations, and the optical constants of distilled water. Phase shift and phase difference spectra were obtained by respectively applying a Kramers-Kronig dispersion analysis to the absolute and relative reflectance spectra. The optical constants of the solutions were determined by algorithms commonly associated with the Kramers-Kronig analysis. Spectral signatures that qualitatively and quantitatively characterize the solute and that show structure of the infrared bands of water were noted in the phase difference spectra. The relative and absolute reflectances, the phase shift and phase difference spectra and the optical constants are presented in graphical form. Application of these results to remote sensing of the chemical quality of natural waters is discussed briefly. Author

N72-29409* Oregon State Univ., Corvallis. Range Management Program.

RESOURCE ANALYSIS AND LAND USE PLANNING WITH SPACE AND HIGH ALTITUDE PHOTOGRAPHY

Barry J. Schrumph *In* NASA. Manned Spacecraft Center. 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 11 p refs

CSCL 02C

Photographic scales providing resource data for decision making processes of land use and a legend system for barren lands, water resources, natural vegetation, agricultural, urban, and industrial lands in hierarchical framework are applied to various remote sensing techniques. Two natural vegetation resource and land use maps for a major portion of Maricopa County, Arizona are also produced. J.A.M.

N72-29452# Aeronautical Chart and Information Center, St. Louis, Mo. Technical Translation Section.

ON LARGE SCALE AEROPHOTO-TOPOGRAPHIC SURVEY OF BUILT UP AREAS

N. A. Sokolova Apr. 1972 16 p Transl. into ENGLISH from *Geodeziya: Kartografiya* (USSR), no. 10, 1971 p 41-47 (AD-741063; ACIC-TC-1825) Avail: NTIS CSCL 08/2

The paper deals with an inexpensive means of producing the planimetric part of a map. This process is called 'photomap'. The problem of producing photomaps of built-up areas must be solved by means of a suitable selection of aerial cameras and scale of photography. The report gives directions for plotting details from photographs by use of a stereoplotter. Author (GRA)

N72-29467*# Barringer Research Ltd., Rexdale (Ontario). RECENT PROGRESS IN THE REMOTE DETECTION OF VAPOURS AND GASEOUS POLLUTANTS

A. J. Moffat and A. R. Barringer [1971] 35 p refs Sponsored in part by NASA (NASA-CR-127632) Avail: NTIS HC \$3.75 CSCL 14B

Work has been continuing on the correlation spectrometry techniques described at previous remote sensing symposiums. Advances in the techniques are described which enable accurate quantitative measurements of diffused atmospheric gases to be made using controlled light sources, accurate quantitative measurements of gas clouds relative to background using solar illumination and semi-quantitation measurements of well diffused atmospheric gases using solar illumination. Specific applications of these techniques are described including preliminary results of a high altitude balloon experiment designed to test the feasibility of measuring pollution at the earth's surface from high altitude balloons and satellites. Author

N72-29973# Washington Univ., Seattle. Dept. of Urban Planning.

URBAN AND REGIONAL PLANNING UTILIZATION OF REMOTE SENSING DATA: A BIBLIOGRAPHY AND REVIEW OF PERTINENT LITERATURE Technical Report, 1 May 1971 - 31 Mar. 1972

Frank V. Westerlund Apr. 1972 233 p refs

(Contract DI-14-08-001-12864)

(USGS-242; USGS-DO-72-019; TR-1) Avail: NTIS HC \$13.75 CSCL 13B

The relationships between the capabilities of the different remote sensors and the range of data peculiar to urban planning are examined. An urban planning perspective of the remote sensing field is developed and an overview of relevant aspects of applications research is presented. A bibliography of literature related to the urban planning problem is included. P.N.F.

N72-29985# RAND Corp., Santa Monica, Calif.

THE PRICE OF FIRE: THE APPLICATION OF MODERN TECHNOLOGY TO THE IMPROVEMENT OF MAN'S ENVIRONMENT

R. M. Salter and P. T. VanDyke May 1972 28 p refs (P-4700) Avail: NTIS HC \$3.50

02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

Ways in which technology can be applied to the solution of environmental problems are discussed. Environmental technology is divided into monitoring technology and abatement technology, and examples of each are given. The abatement technology is considered with respect to energy production and consumption, transportation, and waste disposal and prevention. Monitoring is accomplished by aircraft and spacecraft surveys, computerized simulation, and a variety of sensors, detectors, and techniques.

N.E.N.

N72-30306*# Purdue Univ., Lafayette, Ind.
A LAND USE CLASSIFICATION OF THE ERTS-A, COLLIN COUNTY, TEXAS, SUBFRAME OF THE TEXOMA FRAME
Marion F. Baumgardner, Principal Investigator 15 Sep. 1972 1 p Sponsored by NASA
(E72-10026; NASA-CR-127823) Avail: NTIS HC \$3.00 CSCL 08G

N72-30308*# Honeywell, Inc., St. Paul, Minn.
AUTOMATIC PHOTOINTERPRETATION FOR LAND USE MANAGEMENT IN MINNESOTA Progress Report
George Swanlund, Principal Investigator 31 Jul. 1972 3 p Sponsored by NASA
(E72-10028; NASA-CR-127893; PR-2) Avail: NTIS HC \$3.00 CSCL 14E

N72-30312*# Tri-State Regional Planning Commission, New York.
INVESTIGATION OF SATELLITE IMAGERY FOR REGIONAL PLANNING Progress Report
William Harting, Principal Investigator 12 Jul. 1972 1 p Sponsored by NASA
(E72-10032; NASA-CR-127897; PR-1) Avail: NTIS HC \$3.00 CSCL 08B

N72-30315*# Maryland Dept. of State Planning, Baltimore.
INVESTIGATION OF APPLICATION OF ERTS-A DATA TO INTEGRATED STATE PLANNING IN MARYLAND Progress Report
Edwin L. Thomas, Principal Investigator 10 Aug. 1972 5 p Sponsored by NASA
(E72-10035; NASA-CR-127900; PR-1) Avail: NTIS HC \$3.00 CSCL 08B

N72-30318*# California Univ., Riverside. Dept. of Geography.
MONITORING THE EVOLVING LAND USE PATTERNS USING REMOTE SENSING
Darryl R. Goehring Oct. 1971 110 p refs
(Grant NGL-05-003-404; Contract N00014-69-A-0200-5001 NR Proj. 387-047; Proj. Themis)
(NASA-CR-127834; T-71-5) Avail: NTIS HC \$7.50 CSCL 13B

The urbanization of Walnut Valley from 1953-71 prompted land use change from intensive von Thunen market-oriented patterns to extensive, disinvested, production-factor-minimized patterns. Shortrun, interim land use planning, has allowed agriculture to persist but only in the form of barley farming and grazing. Aerial photography used synoptically recorded six periods of land use change that bracketed dates before and after the freeway was announced and built. Interpretations of these changes help recognize potential conversions to urban uses which allow guidelines to be established that deal with rural-urban transition problems before they arise.

Author

N72-30357# Edgerton, Germeshausen and Grier, Inc., Las Vegas, Nev.

ENVIRONMENTAL RADIATION SURVEYS AND SNOW MASS PREDICTIONS FROM AIRCRAFT

L. J. Deal (AEC, Washington, D. C.), J. F. Doyle, Z. G. Burson, and A. E. Fritzsche 25 Jun. 1971 23 p Presented at 7th Intern. Symp. on Remote Sensing of Environment, Ann Arbor, Mich., 17-21 May 1971 Sponsored by AEC
(EGG-1183-1522; Conf-710540-1; L-1034) Avail: NTIS

An aerial radiation detection and tracking system is described and its use in recording radiation levels from isotopes in air, on the ground, or in the soil is discussed. Information is included on instrumentation and radioisotope detectability. Experiments and field tests are described to illustrate the capabilities of the system.

NSA

N72-30382# McGill Univ., Montreal (Quebec). Faculty of Graduate Studies and Research.

THE REMOTE SENSING OF SURFACE RADIATIVE TEMPERATURE OVER BARBADOS

Benjamin J. Garnier, Dec. 1971 80 p refs
(Contract N00014-68-C-0307; NR Proj. 389-152)
(AD-741188; TR-3) Avail: NTIS CSCL 04/1

The remote sensing of surface radiative temperature over Barbados was undertaken using a PRT-5 attached to a light aircraft. Traverses across the centre of the island, over the rugged east coast area, and the urban area of Bridgetown were undertaken at different times of day and night in the last week of June and the first week of December, 1969. These traverses show that surface variations in long-wave radiation emission lie within plus or minus 5% of the observations over grass at a representative site. The quick response of the surface to sunset and sunrise was noticeable, as was the rapid early heating of east-facing slopes. Surface variations were negligible at night, when the island's surface temperatures were a few degrees below sea temperature.

Author (GRA)

N72-30392*# Metropolitan Washington Council of Governments, D.C. Dept. of Health and Environmental Protection.

AN ASSESSMENT OF REMOTE SENSOR IMAGERY IN THE DETERMINATION OF HOUSING QUALITY DATA

Harry J. Mallon and Joan Y. Howard Nov. 1971 52 p refs
(Contract NASA Order W-13318; Contract DI-14-08-0001-12708)
(NASA-CR-127865; USGS-IR-NASA-228) Avail: NTIS HC \$4.75 CSCL 14E

Selected census tracts in the metropolitan Washington area were examined using varying scales of aerial photography. Observable characteristics of housing and neighborhoods were assessed to determine feasibility of providing data on housing stock and quality and neighborhood condition from the imagery. Small scale imagery is shown to be of relatively marginal value in providing much of the data in the detail required, but can be useful for general survey purposes.

Author

N72-31327*# Wisconsin Univ., Madison.

EVALUATION OF THE APPLICATION OF ERTS-A DATA TO THE REGIONAL LAND USE PLANNING PROCESS

Progress Report, period ending 1 Aug. 1972
James L. Clapp, Principal Investigator 1 Aug. 1972 12 p Sponsored by NASA
(E72-10036; NASA-CR-127484) Avail: NTIS HC \$3.00 CSCL 08E

N72-31330*# Dartmouth Coll., Hanover, N.H.

URBAN-FIELD LAND USE IN SOUTHERN NEW ENGLAND: A FIRST LOOK

Robert B. Simpson, Principal Investigator 28 Sep. 1972 7 p Presented as Preliminary Findings from Analyses of ERTS Observations, NASA Goddard Space Flight Center, Greenbelt, Md., 29 Sep. 1972 Original contains color illustrations. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
(Contract NAS5-21749)

02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

(E72-10039; NASA-CR-128120) Avail: NTIS HC \$3.00 CSCL 08B

There are no author-identified significant results in this report. First look evaluation of ERTS-1 multiband imagery for urban-field land use applications revealed a great deal of potentially valuable information. The amount of land use detail which can be extracted confidently from ERTS imagery is encouraging, and the objectives of the proposed project are considered feasible providing timely cloud-free coverage is available. A.L.

N72-31353*# Bendix Corp., Ann Arbor, Mich.
ECOLOGICAL EFFECTS OF STRIP MINING IN OHIO
Progress Report, period ending 5 Aug. 1972
Phillip E. Chase, Principal Investigator 5 Aug. 1972 3 p
(Contract NAS5-21762)
(E72-10089; NASA-CR-128084; Rept-72-141-922) Avail:
NTIS HC \$3.00 CSCL 08G

N72-31358*# Maine Dept. of Transportation, Augusta.
DETECTION AND MONITORING VEGETATION DAMAGE ASSOCIATED WITH HIGHWAYS AND HIGHWAY FACILITIES Progress Report, period ending 1 Sep. 1972
Ernest G. Stoeckler, Principal Investigator 1 Sep. 1972 1 p
Sponsored by NASA
(E72-10076; NASA-CR-128091; PR-2) Avail: NTIS HC \$3.00 CSCL 02C

N72-31361*# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
ARCTIC AND SUBARCTIC ENVIRONMENTAL ANALYSES UTILIZING ERTS-1 IMAGERY Bimonthly Progress Report, 23 Jun. - 23 Aug. 1972
Duwayne M. Anderson, Principal Investigator, R. K. Haugen, L. W. Gatto, C. W. Slaughter, and T. Marlar 23 Aug. 1972 3 p
Sponsored by NASA
(E72-10080; NASA-CR-128095; BMPR-1) Avail: NTIS HC \$3.00 CSCL 08E

N72-31362*# Tennessee Univ., Knoxville. Dept. of Geography.
GEOGRAPHIC APPLICATIONS OF ERTS-1 IMAGERY TO RURAL LANDSCAPE CHANGE Progress Report
John B. Rehder, Principal Investigator 21 Aug. 1972 3 p
Sponsored by NASA
(E72-10082; NASA-CR-128097) Avail: NTIS HC \$3.00 CSCL 08F

N72-31364*# Environmental Research Inst. of Michigan, Ann Arbor.
BARGE DUMPING OF WASTES IN THE NEW YORK BIGHT
C. T. Wezernak, Principal Investigator and Fred J. Thomson, Principal Investigator 25 Sep. 1972 2 p Sponsored by NASA
(E72-10084; NASA-CR-128099; Rept-011229-6-S) Avail:
NTIS HC \$3.00 CSCL 08A

N72-31366*# Mississippi State Univ., State College. Coll. of Engineering.
STUDY OF THE APPLICATION OF REMOTE SENSING DATA TO LAND USE PLANNING ON THE MISSISSIPPI GULF COAST Progress Report, period ending 30 Sep. 1972

Frank Ingels, Principal Investigator 1 Oct. 1972 2 p
(Contract NAS5-21817)

(E72-10087; NASA-CR-128102) Avail: NTIS HC \$3.00 CSCL 08B

N72-31514*# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
THE DEVELOPMENT OF A LASER FLUORESENSOR FOR REMOTE ENVIRONMENTAL PROBING
R. M. Measures and M. Bristow [1970] 7 p refs
Avail: NTIS HC \$3.00

The first phase of a development program devoted to the exploitation of laser induced fluorescence for environmental sensing is presented. A prototype laser fluorosensor was constructed and used to evaluate, in the laboratory, the feasibility of this concept and to explore the potential range of applications. Special attention was given to assessing the ability of a laser fluorosensor to map the extent of an oil slick, locate the source of lignin sulphonate pollution, and monitor the dispersal of a tracer dye for hydrologic uses. The preliminary results of the study are encouraging. Author

N72-32341*# Maine Dept. of Transportation, Augusta.
TO DEVELOP A LAND USE-PEAK RUNOFF CLASSIFICATION SYSTEM FOR HIGHWAY ENGINEERING PURPOSES
Progress Report, period ending 30 Sep. 1972
Ernest G. Stoeckler, Principal Investigator 1 Oct. 1972 2 p
(Contract NAS5-21772)
(E72-10088; NASA-CR-128137; PR-2) Avail: NTIS HC \$3.00 CSCL 08B

N72-32342*# Geological Survey, Washington, D.C.
CENTRAL ATLANTIC REGIONAL ECOLOGICAL TEST SITE: A PROTOTYPE REGIONAL ENVIRONMENT INFORMATION SYSTEM Progress Report, 1 Jul. - 31 Aug. 1972
Robert H. Alexander, Principal Investigator 1 Sep. 1972 3 p
Sponsored by NASA
(E72-10089; NASA-CR-128138) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. Prior to the actual testing of data from ERTS-1, the principal scientific results to date are the establishment of a model or design for a regional land use information system based on remote sensor data and a firm establishment of the RB-57 type high altitude aircraft data base as an important tool in land use mapping. Preliminary user evaluations of the resulting land use data have been favorable, and one of the states, Maryland, has adopted the USGS-GAP land use system as a first step towards mapping their entire state. The State is funding an extension (to the west) of the part of Maryland not covered by CARETS (Central Atlantic Regional Ecological Test Site), using the GAP land use classification and mapping procedures.

N72-32351*# Geological Survey, McLean, Va. Topographic Div.
MAN-MADE CULTURE INTERPRETATION AND CULTURE REVISION OF SMALL SCALE MAPS Progress Report, 1 Jul. - 31 Aug. 1972
William J. Kosco, Principal Investigator 1 Sep. 1972 3 p
Sponsored by NASA
(E72-10098; NASA-CR-128147) Avail: NTIS HC \$3.00 CSCL 08B

02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

N72-32352*# Geological Survey, Washington, D.C.
THE UTILIZATION OF ERTS-1 GENERATED PHOTOGRAPHS IN THE EVALUATION OF THE IRANIAN PLAYAS AS POTENTIAL LOCATIONS FOR ECONOMIC AND ENGINEERING DEVELOPMENT Progress Report, 1 Jul. - 31 Aug. 1972
Daniel B. Krinsley, Principal Investigator 1 Sep. 1972 2 p
Sponsored by NASA
(E72-10099; NASA-CR-128148) Avail: NTIS HC \$3.00 CSCI 08F

N72-32357*# Geological Survey, Denver, Colo.
1 TEST AND EVALUATION OF ERTS-A DATA APPLICATIONS TO A PRESENT STATUS INVENTORY OF THE POST-1890 AD EPISODE OF ACCELERATED EROSION, AND TO MONITORING FUTURE EROSIONAL CHANGES, WITH SPECIFIC REFERENCE TO THE ARIZONA REGIONAL ECOLOGICAL TEST SITE Progress Report, 1 Jul. - 31 Aug. 1972
Roger B. Morrison, Principal Investigator 1 Sep. 1972 2 p
Sponsored by NASA
(E72-10104; NASA-CR-128153) Avail: NTIS HC \$3.00 CSCI 08M

N72-32361*# Geological Survey, Washington, D.C.
LAND USE MAPPING AND MODELING FOR THE PHOENIX QUADRANGLE Progress Report, 1 Jul. - 31 Aug. 1972
John L. Place, Principal Investigator 1 Sep. 1972 3 p
Sponsored by NASA
(E72-10109; NASA-CR-128159) Avail: NTIS HC \$3.00 CSCI 08B

N72-32376*# Alaska Univ., College.
FEASIBILITY STUDY FOR LOCATING ARCHAEOLOGICAL VILLAGE SITES BY SATELLITE REMOTE SENSING TECHNIQUES Bimonthly Progress Report
John P. Cook, Principal Investigator 30 Sep. 1972 4 p
Sponsored by NASA
(E72-10128; NASA-CR-128182; BMPR-1) Avail: NTIS HC \$3.00 CSCI 08B

The author has identified the following significant results. As a result of ground truth activities, the accurate geographic location of an old fish camp was established as 64 deg 12 min 38 sec N, 158 deg 30 min 42 sec W. Previously the location of this very large abandoned village site was given only on a map sketched in 1935. This location and two other nearby sites will be used as ERTS training areas.

N72-32422# Batelle Columbus Labs., Ohio.
AMCHITKA BIOENVIRONMENTAL PROGRAM. APPLICATION OF PHOTOGRAMMETRIC TECHNIQUES FOR ENVIRONMENTAL SURVEILLANCE OF AMCHITKA ISLAND, ALASKA Annual Progress Report, 1 Jul. 1969 - 30 Jun. 1970
Joachim G. Stephan and Ian M. Mercier Mar. 1972 49 p refs
(Contract AT(26-1)-171)
(BMI-171-135) Avail: NTIS

Three aerial photogrammetric surveys were made to determine sea otter abundance and distribution at Amchitka Island, Alaska. Kodak Ektachrome Aero Film Type 8443 was found to be particularly useful in these surveys because it renders sea otters black and the sea blue in oblique photography. Results indicate that about 2800 sea otters were in the Amchitka area (out to 5 miles from shore) during the survey period. This estimate was obtained by employing the largest number counted during any survey and increasing this by 15 percent to account for animals that, because of their behavior, were not photographed (diving for food, etc.). Color, infrared

color, and panchromatic photography were also used to document the bioenvironmental effects of Milrow, an underground nuclear test conducted on October 2, 1969. Normal color film was found to be superior to other film types for detecting fresh rock falls, soil slides, and turbid waters. Infrared color films yielded the best information about vegetation. Most disturbances were noted on the Pacific coastline. A single large slide (located in Square Bay and involving about 7,000 cu yd of rock movement) was noted on the Bering side. There were few other damage sites on that side.
Author (NSA)

N72-32780# National Environmental Satellite Service, Washington, D.C.
SATELLITE MEASUREMENTS OF AEROSOL BACKSCATTERED RADIATION FROM THE NIMBUS F EARTH RADIATION BUDGET EXPERIMENT
H. Jacobowitz, W. L. Smith, and A. J. Drummond (Eppler Lab., Inc.) Aug. 1972 12 p refs Presented at the Am. Meteorol. Soc. and Air Pollution Control Assoc. Conf. on Air Pollution Meteorol., Raleigh, N. C., 5-9 Apr. 1971
(NOAA-TR-NESS-60) Avail: SOD \$0.25

Instruments are considered which are used to investigate the backscatter from atmospheric aerosols together with accurate quantitative determinations of earth atmosphere radiation budgets on both synoptic and planetary scales. The possibility is discussed of obtaining measurements of the degree of polarization of backscattered radiation in the visible spectrum as part of a future satellite project that could be based upon the earth radiation budget experiment. These measurements, together with radiation intensity determinations, might permit diagnosing particulate pollutants (aerosols) and monitoring their transport. Simultaneous fixed (wide-angle) and scanning (narrow-angle) integral short-wavelength and long-wavelength outgoing energy flux determinations will permit detailed study of the regional and global influence of atmospheric aerosol pollutants on the heat budget. In 1974, the radiometer is to fly aboard the Nimbus F satellite.
Author

N72-33300*# Pennsylvania State Univ., University Park. Space Science and Engineering Lab.
INTERDISCIPLINARY APPLICATIONS AND INTERPRETATIONS OF ERTS DATA WITHIN THE SUSQUEHANNA RIVER BASIN: RESOURCE INVENTORY, LAND USE AND POLLUTION Progress Report, 1 Jul. - 1 Aug. 1972
George J. McMurtry, Principle Investigator 7 Sep. 1972 1 p
(Contract NAS5-23133)
(E72-10066; NASA-CR-128082) Avail: NTIS HC \$3.00 CSCI 08H

N72-33301*# Geological Survey, Washington, D.C.
CENSUS CITIES EXPERIMENT IN URBAN CHANGE DETECTION Progress Report, 1 Jul. - 31 Aug. 1972
James R. Wray, Principal Investigator 1 Sep. 1972 4 p
Sponsored by NASA
(E72-10117; NASA-CR-128166) Avail: NTIS HC \$3.00 CSCI 08F

N72-33317*# Old Dominion Univ. Research Foundation, Norfolk, Va.
TASK 1: CORRELATION OF SATELLITE AND GROUND DATA IN AIR POLLUTION STUDIES. TASK 2: INVESTIGATION TO RELATE THE CHLOROPHYLL AND SUSPENDED SEDIMENT CONTENT IN THE WATERS OF THE LOWER CHESAPEAKE BAY TO ERTS-1 IMAGERY. TASK 3: THE USE OF ERTS-1 TO MORE FULLY UTILIZE AND APPLY MARINE STATION DATA TO THE STUDY OF PRODUCTIVITY ALONG THE EASTERN SHELF EXPANDED WATERS OF THE UNITED STATES Bimonthly Progress Report, 1 Aug. - 30 Sep. 1972

02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

G. E. Copeland, Principal Investigator, A. R. Bandy, P. Fleischer, John C. Ludwick, Principal Investigator, W. J. Hanna, T. A. Gosink, D. W. Bowker, and Howard G. Marshall, Principal Investigator 30 Sep. 1972 12 p
(Contract NAS5-21816)
(E72-10160; NASA-CR-128311) Avail: NTIS HC \$3.00 CSCL 08A

The author has identified the following significant results. Analysis of U-2 imagery of CARETS site indicates smoke plumes can be easily detected. First look at selected ERTS-1 color composites demonstrates plumes from forest fires can be detected.

N72-33320* Mitre Corp., McLean, Va.
ENVIRONMENTAL INDICES FROM ERTS-1 Bimonthly Progress Report
Richard S. Greeley, Principal Investigator 31 Oct. 1972 6 p
(Contract NAS5-21482)
(E72-10163; NASA-CR-128314) Avail: NTIS HC \$3.00 CSCL 08E

N72-33321* Vermont Univ., Burlington.
ENVIRONMENTAL STUDY OF ERTS-1 IMAGERY, LAKE CHAMPLAIN BASIN AND VERMONT Bimonthly Progress Report, Aug. - Sep. 1972
A. O. Lind, Principal Investigator 1 Oct. 1972 3 p
(Contract NAS5-21753)
(E72-10164; NASA-CR-128325) Avail: NTIS HC \$3.00 CSCL 08H

N72-33627* General Electric Co., Syracuse, N.Y. Electronics Lab.
FIELD STUDY ON APPLICATION OF LASER COINCIDENCE ABSORPTION MEASUREMENT TECHNIQUES Final Report
Feb. 1972 75 p refs
(Contract EPA-EHSD-71-8)
(PB-210671; APTD-0981) Avail: NTIS HC \$4.50 CSCL 13B

A field study was conducted on the merits and limitations of laser coincidence absorption measurement technique applied to long path monitoring of a gaseous pollutant in an urban atmosphere. Two gaseous pollutants, ethylene and ammonia, were selected and spectral interferences identified. Using a spectrally tunable CO₂ laser, measurement and system evaluation were conducted. Selected pollutant concentrations and spectral interference effects were recorded. Concurrent point measurements were made by gas chromatograph for ethylene concentrations. Overall system effectiveness and test results were analyzed and performance evaluated. GRA

N72-33963* Brevard County Planning Dept., Titusville, Fla.
URBAN AND REGIONAL PLANNING Progress Report
John W. Hannah, Principal Investigator 2 Oct. 1972 1 p
Sponsored by NASA
(E72-10146; NASA-CR-127331) Avail: NTIS HC \$3.00 CSCL 13B

N73-10349* Grumman Ecosystems Corp., Bethpage, N.Y.
TO DETERMINE THE BOUNDARIES OF AIRCRAFT AND SPACECRAFT DATA WITHIN WHICH USEFUL WATER QUALITY INFORMATION CAN BE OBTAINED Progress Report, 1 Sep. - 1 Nov. 1972
W. C. Coulbourn, Principal Investigator 8 Nov. 1972 3 p
(Contract NAS5-21811)
(E72-10168; NASA-CR-128359; GEC72L-1090) Avail: NTIS HC \$3.00 CSCL 08H

N73-10356* Tennessee Univ., Knoxville. Dept. of Geography.
GEOGRAPHIC APPLICATIONS OF ERTS-1 IMAGERY TO RURAL LANDSCAPE CHANGE
John B. Rehder, Principal Investigator [1972] 4 p Presented at Ann. Meeting of Southeastern Div. of Assoc. of Am. Geographers, Miami, Fla., 19-21 Nov. 1972 Submitted for publication Sponsored by NASA
(E72-10177; NASA-CR-128371) Avail: NTIS HC \$3.00 CSCL 08F

N73-10357* Earth Satellite Corp., Washington, D.C. Geosciences and Environmental Applications Div.
APPLICATION OF ERTS-A DATA TO THE PROTECTION AND MANAGEMENT OF NEW JERSEY'S COASTAL ENVIRONMENT Progress Report, 1 Jul. - 1 Sep. 1972
Roland S. Yunghans, Principal Investigator, Edward B. Feinberg, and Frank J. Wobber, Principal Investigator 29 Sep. 1972 4 p refs Prepared in cooperation with N. J. Dept. of Environ. Protection (Contract NAS5-21765)
(E72-10178; NASA-CR-128373) Avail: NTIS HC \$3.00 CSCL 08C

The author has identified the following significant results. Apparent sewage sludge disposal by barge has been detected approximately 12 miles offshore in an area with an approximate radius of 2.5 nautical miles. Verification is underway to determine whether this dumping is within one of the approved dump sites in the Bight. Analysis of all available historical and routine meteorological data in correlation with the observed phenomenon is necessary before final conclusions can be reached with respect to the effects of currents on the disposal of dumped wastes. Four effluent plumes emanating from the shoreline just south of Sandy Hook were observed and are moving in a southerly direction. Another plume is evident north of Barnegat Inlet and is moving almost directly offshore. This suggests that the more northerly plumes are under the influence of the tidal regime around New York Harbor much more than are the plumes further south along the New Jersey coast. Of further interest are what appear to be an internal wave phenomena approximately 75 miles east of the New Jersey coast. This same sort of phenomena has been observed repetitively off the coast of Oregon.

N73-10361* Oregon State Univ., Corvallis. School of Agriculture.
COMPARATIVE EVALUATION OF ERTS-A IMAGERY FOR RESOURCE INVENTORY IN LAND-USE PLANNING Progress Report, period ending 31 Oct. 1972
Gerald H. Simonson, Principal Investigator 10 Nov. 1972 22 p
Sponsored by NASA
(E72-10182; NASA-CR-128331) Avail: NTIS HC \$3.25 CSCL 08G

There are no author-identified significant results in this report. The overall objectives of this program are: (1) use of multidiscipline team approach to determine features that can be successfully monitored by ERTS-1 imagery for resource inventory, planning, land use zoning, and resource development; and (2) using carefully selected sample areas, develop a comprehensive resource inventory mapping system for use in planning, zoning, and resource development. Progress has included compilation and organization of ground truth data and observations in the primary study area of Crook County; resource inventory legend development; assembly and testing of color enhancement equipment; development and adaption of programs for digital data processing; and quick-look evaluations of initial ERTS-1 imagery for Oregon.

A.L.

N73-10367* Dartmouth Coll., Hanover, N.H. Dept. of Geography.
LAND USE IN NORTHERN MEGALOPOLIS Progress Report
Robert B. Simpson 10 Nov. 1972 3 p refs
(Contract NAS5-21749)
(E72-10188; NASA-CR-128386; PR-3) Avail: NTIS HC \$3.00 CSCL 08B

02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

N73-10371*# Argus Exploration Co., Los Angeles, Calif.
A RECONNAISSANCE SPACE SENSING INVESTIGATION OF THE CRUSTAL STRUCTURE FOR A STRIP FROM THE EASTERN SIERRA NEVADA TO THE COLORADO PLATEAU: APRIL 1971 Progress Report, 1 Sep. - 31 Oct. 1972
Ira C. Bechtold, Principal Investigator and Mark A. Liggett 9 Nov. 1972 11 p
(Contract NAS5-21809)
(E72-10192; NASA-CR-128390) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. An area of anomalous linear topographic grain and color expressions was recognized in Apollo 9 and ERTS-1 imagery along the Colorado River of northwestern Arizona and southern Nevada. Field reconnaissance and analysis of U-2 photography has shown the anomaly to be a zone of north to north-northwest trending dike swarms and associated granitic plutons. The dikes vary in composition from rhyolite to diabase, with an average composition nearer rhyolite. Shearing and displacement of host rocks along dikes suggest dike emplacement along active fault zones. Post-dike deformation has resulted in shearing and complex normal faulting along a similar north-south trend. The epizonal plutonism and volcanism of this north-south belt appears to represent a structurally controlled volcanogenic province which ends abruptly in the vicinity of Lake Mead at a probable eastern extension of the Las Vegas Shear Zone. The magnitude and chronology of extensional faulting and plutonism recognized in the north-south zone, support the hypothesis that the Las Vegas Shear Zone is a transform fault separating two areas of crustal spreading.

N73-10374*# Minnesota Univ., Minneapolis.
LAND USE MANAGEMENT IN MINNESOTA Progress Report, 1 Sep. - 31 Oct. 1972
Joseph E. Sizer, Principal Investigator 31 Oct. 1972 3 p
Sponsored by NASA
(E72-10195; NASA-CR-128410) Avail: NTIS HC \$3.00 CSCL 08M

The author has identified the following significant results. Preliminary analysis of bulk imagery suggests that the forty-acre data cell used in the Minnesota Land Management Information Systems (MLMIS) can be utilized in interpretation of ERTS-1 data. High quality bulk images of the Twin Cities metropolitan area suggest that detail in urban land use patterns is much greater than originally anticipated. This implies a greater work effort in this area than was planned. Furthermore, the forest classes of land use can also be usefully divided into subcategories. Preliminary analysis of one rather low quality image also indicates that subclasses of wetlands can be identified. Prospects are bright for improving the potential detail that ERTS-1 can contribute to MLMIS.

N73-11304*# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
ARTIC AND SUBARCTIC ENVIRONMENTAL ANALYSES UTILIZING ERTS-1 IMAGERY. COLD REGIONS ENVIRONMENTAL ANALYSIS BASED ON ERTS-1 IMAGERY (PREPRINT) Bimonthly Progress Report, 23 Aug. - 23 Oct. 1972
Duwayne M. Anderson, Principal Investigator, R. K. Haugen, L. W. Gatto, C. W. Slaughter, T. Marlar, and H. L. McKim 23 Oct. 1972 19 p refs Preprint presented at 8th Intern. Symp. on Remote Sensing of Environ., Ann Arbor, Mich., 2-6 Oct. 1972 Original contains imagery. Original photography may be purchased from EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
(NASA Order S-70253-AG)
(E72-10209; NASA-CR-128480; BMPR-2) Avail: NTIS HC \$3.00 CSCL 08L

There are no author-identified significant results in this report. An overriding problem in arctic and subarctic environmental research has been the absence of long-term observational data and the sparseness of geographical coverage of existing data. A first look report is presented on the use of ERTS-1 imagery as a major tool in two large area environmental studies: (1) investigation of sedimentation and other nearshore marine

processes in Cook Inlet, Alaska; and (2) a regional study of permafrost regimes in the discontinuous permafrost zone of Alaska. These studies incorporate ground truth acquisition techniques that are probably similar to most ERTS investigations. Studies of oceanographic processes in Cook Inlet will be focused on seasonal changes in nearshore bathymetry, tidal and major current circulation patterns, and coastal sedimentation processes, applicable to navigation, construction, and maintenance of harbors. Analyses will be made of the regional permafrost distribution and regimes in the Upper Koyukuk-Kobuk River area located in NW Alaska. A.L.

N73-11316*# Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.
LAND USE CLASSIFICATION IN THE SOUTHEASTERN FOREST REGION BY MULTISPECTRAL SCANNING AND COMPUTERIZED MAPPING
Fred J. Thomson, Principal Investigator (Mich. Univ., Ann Arbor), F. P. Weber, R. C. Aldrich, and F. G. Sadowski (Mich. Univ., Ann Arbor) 6 Oct. 1972 1 p Presented at 8th Intern. Symp. on Remote Sensing of Environment, Ann Arbor, Mich., 6 Oct. 1972
(NASA Order S-70251-AG)
(E72-10222; NASA-CR-128489) Avail: NTIS HC \$3.00 CSCL 08B

N73-11320*# Honeywell, Inc., St. Paul, Minn.
AUTOMATIC PHOTOINTERPRETATION FOR LAND USE MANAGEMENT IN MINNESOTA Progress Report
George D. Swanlund, Principal Investigator Oct. 1972 4 p
(Contract NAS5-21742)
(E72-10227; NASA-CR-129160; PR-3) Avail: NTIS HC \$3.00 CSCL 14E

N73-12334*# Geological Survey, Washington, D.C.
ANALYSIS STUDY OF MULTISPECTRAL DATA, ERTS-A, FROM AN AREA IN WEST PAKISTAN Progress Report, 1 Sep. - 31 Oct. 1972
Robert G. Schmidt, Principal Investigator 1 Nov. 1972 2 p
Sponsored by NASA
(E72-10234; NASA-CR-129111) Avail: NTIS HC \$3.00 CSCL 08F

N73-12336*# Geological Survey, Washington, D.C.
LAND USE MAPPING AND MODELLING FOR THE PHOENIX QUADRANGLE Progress Report, 1 Sep. - 31 Oct. 1972
John L. Place, Principal Investigator 1 Nov. 1972 4 p Sponsored by NASA
(E72-10236; NASA-CR-129113) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. Experimentation with 70mm squares cut from ERTS-1 9.5 inch MSS positive transparencies in an I2S color additive viewer, a Richardson film production viewer at 10X magnification, and in a microfiche viewer at 12X and 18X magnification has indicated that band 5 photography provides the most useful interpretable data. In the I2S viewer high intensities of blue and red light in bands 4 and 6 respectively enhance faint vegetation patterns not easily detectable. Slides produced from 35mm color transparencies made by photographing the I2S viewing screen are suitable visual aids for use during presentation. Interpretation of MSS transparencies allowed compilation of a map of land use change in the Phoenix quadrangle.

N73-12341*# Geological Survey, Washington, D.C.
CENTRAL ATLANTIC REGIONAL ECOLOGICAL TEST SITE: A PROTOTYPE REGIONAL ENVIRONMENTAL INFORMATION SYSTEM Progress Report, 1 Sep. - 31 Oct. 1972
Robert H. Alexander, Principal Investigator 1 Nov. 1972 5 p
Sponsored by NASA
(E72-10241; NASA-CR-129118) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. Preliminary analysis of the capabilities of ERTS-1 data in land use mapping and change detection has revealed that Level 1 land use mapping can be performed and that in some cases land use changes can be identified. Land use interpretation was accomplished with the aid of a film projection viewer and the I2S additive color viewer. By varying the filters and illumination of each spectral band it was possible to better distinguish urban areas and transportation routes. Also it enabled the toning down of signatures such as cropland and forests which on many color infrared composite photographs were washed out with strong red tints. It appears that ERTS-1 imagery is useful not only for Level 1 mapping at scales of 1:250,000 or smaller, but also for monitoring agricultural changes and locating areas of construction, when such land uses approach an area of approximately two hectares.

N73-12344* Geological Survey, Washington, D.C.
CENSUS CITIES EXPERIMENT IN URBAN CHANGE DETECTION Progress Report, 1 Sep. - 31 Oct. 1972
 James R. Wray, Principal Investigators 1 Nov. 1972 5 p
 Sponsored by NASA
 (E72-10244; NASA-CR-129121) Avail: NTIS HC \$3.00 CSCL 05K

N73-12354* Brevard County Planning Dept., Titusville, Fla.
URBAN AND REGIONAL PLANNING Progress Report
 John W. Hannah, Principal Investigator 1 Dec. 1972 3 p
 Sponsored by NASA
 (E72-10254; NASA-CR-129185) Avail: NTIS HC \$3.00 CSCL 08F

N73-12356* Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.
ECOLOGICAL EFFECTS OF STRIP MINING IN OHIO Bimonthly Progress Report, 6 Aug. - 5 Oct. 1972
 Wayne Pettyjohn, Principal Investigator 5 Oct. 1972 4 p
 Prepared in cooperation with Ohio State Univ., Columbus (Contract NAS5-21762)
 (E72-10256; NASA-CR-129188; Rept-72-141-1084) Avail: NTIS HC \$3.00 CSCL 08M

N73-12361* Mississippi State Univ., State College. Dept. of Electrical Engineering.
STUDY OF THE APPLICATION OF REMOTE SENSING DATA TO LAND USE PLANNING ON THE MISSISSIPPI GULF COAST Progress Report
 Frank M. Ingels, Principal Investigator 6 Dec. 1972 5 p
 (Contract NAS5-21817)
 (E72-10262; NASA-CR-129196) Avail: NTIS HC \$3.00 CSCL 08M

N73-12364* Tennessee Univ., Knoxville. Dept. of Geography.
REGIONAL LANDSCAPE CHANGE: A CASE FOR ERTS-1
 John B. Rehder, Principal Investigator and James R. O'Malley 27 Nov. 1972 10 p Proposed for presentation at 69th Ann. Assoc. of Am. Geographers Meetings, Atlanta, 15-18 Apr. 1973
 Submitted for publication Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
 (Contract NAS5-21726)
 (E72-10265; NASA-CR-129227) Avail: NTIS HC \$3.00 CSCL 08M

N73-12367* Vermont Univ., Burlington. Dept. of Geology.
POLLUTION DETECTION IN LAKE CHAMPLAIN USING ERTS-1 IMAGERY
 A. O. Lind, Principal Investigator and E. B. Henson Nov. 1972 11 p Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
 (Contract NAS5-21753)
 (E72-10268; NASA-CR-129230) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. A major waste water discharge plume generated by a large paper mill along the New York shore of Lake Champlain was visually detected on ERTS-1 imagery. The plume is best displayed in 9.5 inch positive transparencies of MSS bands 4 and 5. Observation of the magnitude and extent of this plume is feasible, under magnification of 4 times. The chemical parameters of this plume have been documented by limnological studies. An enhancement technique useful for documenting the presence of waste water discharge plumes in Lake Champlain utilizes Polaroid MP-3 copy camera equipment and Spectral Data Corporation's multispectral viewer. The 9.5 inch, ERTS-1, positive transparency is enlarged using the Polaroid MP-3 copy camera to produce an enlarged lantern slide size positive transparency. These are projected through the multispectral viewer for enhancement and the scene is viewed directly on the screen or copied by an additional photographic step. The technique is simple and produces rapid results.

N73-12369* Geological Survey, Washington, D.C.
THE UTILIZATION OF ERTS-1 GENERATED PHOTOGRAPHS IN THE EVALUATION OF THE IRANIAN PLAYAS AS POTENTIAL LOCATIONS FOR ECONOMIC AND ENGINEERING DEVELOPMENT Progress Report, 1 Sep. - 31 Oct. 1972
 Daniel B. Krinsley, Principal Investigator 29 Nov. 1972 3 p
 (NASA Order S-70243-AG-3)
 (E72-10270; NASA-CR-129232) Avail: NTIS HC \$3.00 CSCL 08M

N73-12409 Elliott-Automation Space and Advanced Military Systems, Ltd., Camberley (England).
TRANSPORT APPLICATIONS OF SIDE-LOOKING RADAR
 N. R. Cox In *its* Side-looking Radar Systems and their potential Appl. to Earth Resource Surveys, Vol. 3 Aug. 1972 p 123-149 refs

The applications of SLR to transport planning, management, and control are considered. The present use of SLR in transport problems is outlined, and potential applications such as route planning, traffic, and navigation studies are discussed.

Author (ESRO)

N73-12411* Battelle Columbus Labs., Ohio.
AMCHITKA BIOENVIRONMENTAL PROGRAM: AERIAL AND GROUND TRUTH PHOTOGRAPHY FOR ENVIRONMENTAL SURVEILLANCE OF AMCHITKA ISLAND, ALASKA Annual Progress Report, 1 Jul. 1970 - 30 Jun. 1971
 Joachim G. Stephan May 1972 25 p refs
 (Contract AT(26-1)-171)
 (BML-171-146) Avail: NTIS

A photographic aerial survey was conducted over the site of the underground nuclear test Milrow to record potential long-term changes to the bioenvironment. An aerial survey was also made over the Cannikin test site to document pre-shot bioenvironmental conditions. Color, infrared color, and black and white films were used to record an area up to 80 square kilometers. Multispectral photography was taken over selected areas to test its applicability to the bioenvironmental program.

Author

N73-12662* Sandia Labs., Albuquerque, N.Mex.
PROCEEDINGS OF THE SYMPOSIUM ON AIR POLLUTION, TURBULENCE, AND DIFFUSION
 H. W. Church, ed. and R. E. Luna, ed. Mar. 1972 398 p refs
 Symp. held at N. Mex. State Univ., 7-10 Dec. 1971 Sponsored by AEC
 (SC-M-710913; Conf-711219) Avail: NTIS

The 51 papers presented at the conference are compiled. The major topics included: air resources management; instrumentation and remote sensing equipment and methods for turbulence, diffusion, temperature distribution, and aerosol content measurements; theory of turbulence and the Boundary Layer I; climatic effects; and diffusion prediction methods. NSA

02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

N73-12721# Western Environmental Research Lab., Las Vegas, Nev.

HUMBOLDT BAY NUCLEAR POWER PLANT SURVEY, MARCH THROUGH MAY 1971

Vernon E. Andrews and Thomas R. Horton Apr. 1972 36 p
(WERLV-1) Avail: NTIS

A pilot study was conducted to evaluate the use of aerial surveillance techniques in tracking and sampling of gaseous effluent from nuclear power plants. Data derived from such measurements would be useful in measuring peak environmental exposures and in determining the effects of local terrain and meteorology on diffusion of the airborne effluent. Exposure rates and concentrations measured during coordinated aerial and ground monitoring for the Humboldt Bay Power Reactor are compared to predicted exposure rates and concentrations based on measured release rates and observed meteorology. Author (NSA)

N73-13333*# Geological Survey, Denver, Colo.

A STUDY OF QUATERNARY LANDFORMS AND MATERIALS IN THE MIDWEST AND GREAT PLAINS Progress Report, 1 Sep. - 31 Oct. 1972

Roger B. Morrison and George R. Hallberg, Principal Investigators (Iowa Geol. Survey) 1 Nov. 1972 11 p
(NASA Order S-70243-AG-1)

(E72-10272; NASA-CR-129234) Avail: NTIS HC \$3.00 CSCL 08M

The author has identified the following significant results. Measurements made from prints of ERTS-1, MSS 5 images, show practical limits of detectability for this imagery in the Midwest. The smallest high contrast object detectable has an approximate measured diameter of 150 feet. The smallest clearly identifiable cultural feature is roughly 300 feet for high contrast, and 400 to 500 feet for low contrast objects. Rural roadways, with an average width of 75 feet, are clearly defined due to high reflectivity, linearity, and the instantaneous field of view of the scanner. On the infrared a farm pond slightly greater than one acre is detectable. Crop and natural foliage cover in the Midwest during summer months obscures geologic and soils information and hinders detailed mapping. In the western Great Plains large-scale mapping of this kind may be possible, even at this time of year. In southwestern Iowa, topographic and drainage system anomalies, revealed by the imagery, are related to the slope of and depth to the buried bedrock surface. In eastern Iowa land use classification can be done from ERTS-1 imagery.

N73-13334*# Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.

DETERMINE UTILITY OF ERTS-1 TO DETECT AND MONITOR AREA STRIP MINING AND RECLAMATION Interim Report, May - Oct. 1972

Philip E. Chase, Principal Investigator Nov. 1972 9 p
(Contract NAS5-21762)

(E72-10284; NASA-CR-129273; BSR-3489) Avail: NTIS HC \$3.00 CSCL 08I

There are no author-identified significant results in this report. Analysis of the strip mine records and aerial photos in the test site (five counties in southeastern Ohio) indicate rapidly increasing stripping in the past few years. The mines are large enough to be detected and their gross characteristics observed in the ERTS-1 imagery. Progress in adapting the Bendix ground station to handling ERTS-1 computer compatible tapes is described.

N73-13338*# Maine Dept. of Transportation, Augusta.

DETECTION AND MONITORING OF VEGETATION DAMAGE ASSOCIATED WITH HIGHWAYS AND HIGHWAY FACILITIES Interim Report, May - Nov. 1972

Ernest G. Stoeckeler, Principal Investigator Nov. 1972 6 p
(Contract NAS5-21724)

(E72-10288; NASA-CR-129278) Avail: NTIS HC \$3.00 CSCL 13B

N73-13349*# Wisconsin Univ., Madison.

INTERDISCIPLINARY RESEARCH ON THE APPLICATION OF ERTS-1 DATA TO THE REGIONAL LAND USE PLANNING PROCESS

James L. Clapp, Principal Investigator, R. W. Kiefer, M. M. McCarthy, and B. J. Niemann, Jr. 4 Oct. 1972 35 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(Contract NAS5-21754)

(E72-10299; NASA-CR-129548) Avail: NTIS HC \$3.75 CSCL 08G

The author has identified the following significant results. Although the degree to which ERTS-1 imagery can satisfy regional land use planning data needs is not yet known, it appears to offer means by which the data acquisition process can be immeasurably improved. The initial experiences of an interdisciplinary group attempting to formulate ways of analyzing the effectiveness of ERTS-1 imagery as a base for environmental monitoring and the resolution of regional land allocation problems are documented. Application of imagery to the regional planning process consists of utilizing representative geographical regions within the state of Wisconsin. Because of the need to describe and depict regional resource complexity in an interrelatable state, certain resources within the geographical regions have been inventoried and stored in a two-dimensional computer-based map form. Computer oriented processes were developed to provide for the economical storage, analysis, and spatial display of natural and cultural data for regional land use planning purposes. The authors are optimistic that the imagery will provide relevant data for land use decision making at regional levels.

N73-13356*# Purdue Univ., Lafayette, Ind.

AUTOMATIC IDENTIFICATION OF LAND USES FROM ERTS-1 DATA OBTAINED OVER MILWAUKEE, WISCONSIN

Marion F. Baumgardner, D. A. Landgrebe, Principal Investigators, and H. H. Kramer 8 Dec. 1972 2 p

(Contract NAS5-21785)

(E72-10307; NASA-CR-129556) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. Spectrally, thirteen classes of ground cover were identified within Milwaukee County: five classes of water, grassy open areas, beach, two classes of road, woods, suburban, inner city, and industry. A distinct concentric pattern of land use was identified in the county radiating outward from the central business district. The first ring has a principal feature, termed the inner city, which is indicative of the older part of the county. In the second ring, the land use becomes more complex, consisting of suburban areas, parks, and varied institutional features. The third general ring consists primarily of open, grassy land, with scattered residential subdivisions, wood lots, and small water bodies. The five classes of water identified suggest differences in depth, turbidity, and/or color. A number of major roads were identified. Other spectrally identifiable features included the larger county parks and larger cemeteries.

N73-13357*# Maine State Highway Dept., Bangor.

TO DEVELOP A LAND USE-PEAK RUNOFF CLASSIFICATION SYSTEM FOR HIGHWAY ENGINEERING PURPOSES Progress Report

Ernest G. Stoeckeler, Principal Investigator 1 Dec. 1972 1 p
(Contract NAS5-21772)

(E72-10308; NASA-CR-129557; PR-3) Avail: NTIS HC \$3.00 CSCL 08H

N73-13358*# Army Construction Engineering Research Lab., Champaign, Ill.

EFFECTS OF CONSTRUCTION AND STAGED FILLING OF RESERVOIRS ON THE ENVIRONMENT AND ECOLOGY Progress Report, 8 Jun. - 8 Dec. 1972

R. K. Jain, Principal Investigator 7 Dec. 1972 4 p
(NASA Order S-70255-AG)

(E72-10309; NASA-CR-129558) Avail: NTIS HC \$3.00 CSCL 08H

02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

N73-13364*# Tennessee Univ., Knoxville. Dept. of Geography. **GEOGRAPHIC APPLICATIONS OF THE EARTH RESOURCES TECHNOLOGY SATELLITE (ERTS-1) TO LAND-SCAPE CHANGE**

John B. Rehder, Principal Investigator 22 Dec. 1972 2 p
Proposed for presentation at 1st Pan Am. Symp. on Remote Sensing, Panama, 27 Apr. - 2 May 1973
(Contract NAS5-21728)
(E72-10315; NASA-CR-129564) Avail: NTIS HC \$3.00 CSCL 08F

N73-13626# Ludwig-Maximilians-Universitat, Munich (West Germany). Inst. fuer Meteorologie.

APPLICATION OF SPACE TECHNOLOGY TO THE ACQUISITION AND SUPERVISION OF CLIMATIC PARAMETERS AND AIR POLLUTANTS [DIE ANWENDUNG VON WELTRAUMTECHNIKEN AUF DIE ERFASSUNG UND UEBERWACHUNG VON KLIMAPARAMETERN UND LUFTVERUNREINIGENDEN STOFFEN]

Hans-Juergen Bolle Sep. 1972 15 p In GERMAN Presented at the 5th Ann. DGLR Meeting, Berlin, 4-6 Oct. 1972 (DGLR-Paper-72-81) Avail: NTIS HC \$3.00

The possibilities of using satellites for the acquisition and monitoring of climatological parameters and air pollution data are discussed. The parameters of particular interest are: the planetary radiation budget and its space-time variations, clouds, particles, and atmospheric trace gases. Experience is available for some of these parameters from meteorological satellites. A summary is given of observation methods. A particular problem is the long constancy of the necessary radiation detectors and the comparability of results. Author (ESRO)

N73-13838* International Business Machines Corp., Gaithersburg, Md. Federal Systems Div.

APPLICATION OF REMOTE SENSING TO SOLUTION OF ECOLOGICAL PROBLEMS

Andrew Adelman In NASA. Marshall Space Flight Center Space for Mankind's Benefit 1972 p 105-108

CSCL 05K

N73-13840* Barringer Research Ltd., Rexdale (Ontario). **POSSIBILITIES OF OBSERVING AIR POLLUTION FROM ORBITAL ALTITUDES**

A. Barringer In NASA. Marshall Space Flight Center Space for Mankind's Benefit 1972 p 121-139 refs

CSCL 04B

N73-13841* Alabama Univ., University. Dept. of Civil and Medical Engineering.

USE OF DATA FROM SPACE FOR EARTH RESOURCES EXPLORATION AND MANAGEMENT IN ALABAMA

Phillip E. LaMoreaux (Ala. State Oil and Gas Board) and Harold R. Henry In NASA. Marshall Space Flight Center Space for Mankind's Benefit 1972 p 143-148

CSCL 05F

N73-13845* Battelle Columbus Labs., Ohio. Aerospace Mechanics Div.

ORBITAL SURVEYS AND STATE RESOURCE MANAGEMENT

George Wukelic, T. L. Wells (State of Ohio Dept. of Develop.) and B. R. Brace In NASA. Marshall Space Flight Center Space for Mankind's Benefit 1972 p 187-197 refs

CSCL 05F

N73-14069*# Texas Univ., Houston. School of Public Health. **PUBLIC HEALTH APPLICATIONS OF REMOTE SENSING OF THE ENVIRONMENT, AN EVALUATION**

Jan. 1972 158 p refs
(Contract NAS9-11522)
(NASA-CR-129822) Avail: NTIS HC \$10.00 CSCL 06E

The available techniques were examined in the field of remote sensing (including aerial photography, infrared detection, radar, etc.) and applications to a number of problems in the wide field of public health were determined. The specific areas of public health examined included: air pollution, water pollution, communicable disease, and the combined problems of urban growth and the effect of disasters on human communities. The assessment of the possible applications of remote sensing to these problems was made primarily by examination of the available literature in each field, and by interviews with health authorities, physicists, biologists, and other interested workers. Three types of programs employing remote sensors were outlined in the air pollution field: (1) proving ability of sensors to monitor pollutants at three levels of interest - point source, ambient levels in cities, and global patterns; (2) detection of effects of pollutants on the environment at local and global levels; and (3) routine monitoring. Author

N73-14310*# Alabama Univ., University. **INVESTIGATION USING DATA IN ALABAMA FROM ERTS-A Bimonthly Progress Report, period ending 6 Dec. 1972**

Harold R. Henry, Principal Investigator 6 Dec. 1972 55 p Original contains imagery. Original photography may be purchased from the EROS Data center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 Original contains color illustrations (Contract NAS5-21876)

(E72-10319; NASA-CR-129577; BMPR-1) Avail: NTIS HC \$4.75 CSCL 08F

There are no author-identified significant results in this report. Brief summaries are presented of accomplishments by the state of Alabama in the areas of: (1) investigation of environmental factors; (2) land use compilation; (3) data processing for land use compilation; (4) photo-reproduction and unsupervised land use classification from digital tape; (5) data collection buoys; and (6) activities of the Geological Survey of Alabama. A. L.

N73-14312*# North Carolina State Univ., Raleigh. **UTILIZATION OF ERTS-A DATA IN GEOLOGICAL EVALUATION REGIONAL PLANNING, FOREST MANAGEMENT, AND WATER MANAGEMENT IN NORTH CAROLINA. 2: LAND USE SURVEY AND MAPPING. A: LAND USE CLASSIFICATION**

Charles W. Welby, Principal Investigator 15 Dec. 1972 1 p (Contract NAS5-21732)

(E72-10324; NASA-CR-129582) Avail: NTIS HC \$3.00 CSCL 08G

N73-14317*# Pennsylvania State Univ., University Park. Space Science and Engineering Lab.

INTERDISCIPLINARY APPLICATIONS AND INTERPRETATIONS OF ERTS DATA WITHIN THE SUSQUEHANNA RIVER BASIN: RESOURCE INVENTORY, LAND USE, AND POLLUTION Progress Report, 1 Aug. - 1 Oct. 1972

George J. McMurtry, Principal Investigator 27 Dec. 1972 2 p (Contract NAS5-23133)

(E72-10329; NASA-CR-129643) Avail: NTIS HC \$3.00 CSCL 08H

N73-14318*# Mitre Corp., McLean, Va. **INVESTIGATION OF ENVIRONMENTAL INDICES FROM THE EARTH RESOURCES TECHNOLOGY SATELLITES Bimonthly Progress Report**

Richard S. Greeley, Principal Investigator 31 Dec. 1972 7 p (Contract NAS5-21482)

(E72-10330; NASA-CR-129644; D20-667) Avail: NTIS HC \$3.00 CSCL 08E

02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

N73-14326*# Alaska Univ., College.
FEASIBILITY STUDY FOR LOCATING ARCHAEOLOGICAL VILLAGE SITES BY SATELLITE REMOTE SENSING TECHNIQUES Bimonthly Progress Report
John P. Cook, Principal Investigator 30 Nov. 1972 5 p
(Contract NAS5-21833)
(E72-10338; NASA-CR-129652; BMPR-2) Avail: NTIS HC \$3.00 CSCL 08F

N73-14330*# Alaska Univ., College.
IDENTIFICATION OF PHENOLOGICAL STAGES AND VEGETATIVE TYPES FOR LAND USE CLASSIFICATION Bimonthly Progress Report
C. Ivan Branton, Principal Investigator 30 Nov. 1972 3 p
(Contract NAS5-21833)
(E72-10342; NASA-CR-129656; BMPR-2) Avail: NTIS HC \$3.00 CSCL 08M

The author has identified the following significant results. Two procedures for examining ERTS-1 imagery were investigated in cooperation with the photographic services section. Positive, 10X enlargements were produced of spectral bands 4, 6, and 7, for a portion of photo 1033-21020. Adequate detail remained to recognize physical features such as streams, glaciers, ice, and snow. Also the entire image was studied using transparencies produced by the 3M color-key process. A combination of three complementary color combinations produced visually recognizable shades apparently indicating vegetation differences. Also lakes and glacial streams of sufficient size, ice and snow, and drainage patterns can be recognized. A need is indicated for oblique low level color aerial photography in the vicinity of identifiable terrain features to assist in the positive location of vegetative communities appearing in the analysis process. In the primary areas of concern to this project identifiable manmade features are conspicuous by their absence. In image 1049-20505 band 7 produced distinct tonal differences on a mountain slope to river bottom gradient.

N73-14343*# Tennessee Univ., Knoxville. Dept. of Geography.
GEOGRAPHIC APPLICATIONS OF ERTS-A IMAGERY TO RURAL LANDSCAPE CHANGE Progress Report
John B. Rehder, Principal Investigator Dec. 1972 34 p refs
Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
(Contract NAS5-21726)
(E72-10355; NASA-CR-129668) Avail: NTIS HC \$3.75 CSCL 08F

There are no author-identified significant results in this report. The study area, centered on Knoxville, Tennessee, encompasses nearly 20,000 square miles. The Knoxville Test Site, an 11 x 21 mile area over the city of Knoxville and the western portion of Knox County, has been chosen for the analysis of landscape change detection associated with urban growth. The second area, the Cumberland Plateau Test Site, exhibits landscape change through forest alterations and landform disturbances associated with strip mining in the area and was so chosen for its sharp contrasts in physical and human phenomena as well as its change dynamics. Accomplishments since reception of ERTS-1 imagery include: (1) basic cataloging and classifying of the data into a filing system; (2) a densitometer analysis; (3) first look analysis; and (4) preparation of results from the project. Examples of all four bands of the MSS have been received and analyses reveal distinctive positive and negative reactions. Band 5 has been found to be best for landscape analysis of contrasts between urban and rural landscapes, and band 7 for topographic features and water surfaces. Preliminary results are summarized.
A.L.

N73-14345*# Dartmouth Coll., Hanover, N.H.
LAND USE IN NORTHERN MEGALOPOLIS Progress Report
Robert B. Simpson, Principal Investigator 5 Jan. 1973 2 p
(Contract NAS5-21749)
(E72-10357; NASA-CR-129690; PR-4) Avail: NTIS HC \$3.00 CSCL 08F

N73-14346*# Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.

UTILIZATION OF ERTS-1 DATA TO MONITOR AND CLASSIFY EUTROPHICATION OF INLAND LAKES Bimonthly Progress Report, 1 Oct. - 1 Dec. 1972
Phillip E. Chase, Principal Investigator 1 Dec. 1972 7 p
(Contract NAS5-21810)
(E72-10358; NASA-CR-129691) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. Channel 7 is highly useful in surveying surface water in lakes, rivers, and large marshes. It is likely to miss detection of elliptically shaped bodies of 4 acres or less. Further, it is possible that the bodies are distorted and displaced because of lack of correction for sensor response time. These errors might not be critical because: (1) location accuracy is not essential to a surface water survey; and (2) an obviously distorted image is often not in error in excess of 5%. The finding that Orchard Lake and other lakes in Oakland County have different densities in channels 4, 5, 6, and 7 is important because it implies that the lake wide water color average is different in the separate channels. Channels 6 and 7 were constant in tonal quality among all the lakes while channels 4 and 5 varied from lake to lake and in various parts of Orchard Lake. These findings are significant because it means that small inland lake color differences are recorded by the MSS even on a cloudy or hazy day. It also confirms that ERTS-1 is performing well enough to be used for correlation to ground truth and aircraft underflights.

N73-14349*# Spectral Africa (Pty) Ltd., Randfontein (Republic of South Africa).
GROWTH AND DECLINE OF VEGETATION ON MINE DUMPS Progress Report, Nov. - Dec. 1972
B. P. Gilbertson, Principal Investigator 28 Dec. 1972 5 p refs
Sponsored by NASA
(E72-10361; NASA-CR-129693; Rept-72/27; PR-1) Avail: NTIS HC \$3.00 CSCL 08F

N73-14356*# Dartmouth Coll., Hanover, N.H. Dept. of Geology.
LAND USE OF NORTHERN MEGALOPOLIS FROM ERTS-1 IMAGERY Interim Report, Jun. - Nov. 1972
Robert B. Simpson, Principal Investigator 19 Dec. 1972 9 p ref
Original contains color illustrations
(Contract NAS5-21749)
(E72-10368; NASA-CR-129801) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. The preliminary map of land use of Rhode Island is believed to be the first urban-type land use map ever made from satellite imagery, and its preparation a significant scientific result for ERTS-1. Eight categories of land use were differentiated at a scale of 1:250,000 including 3 categories of residential area: single family and multiple/mixed urban types, plus a residential and open space rural one. This compares favorably with RB-57 mapping experience in which, mapping at 1:120,000 from photography taken from 60,000 feet, 11 basic categories of land use were discriminated. From ERTS, the urban cores of cities down to 7,000 population, and commercial and industrial sites down to 800 feet square, were consistently discriminated.

N73-14359*# Maine Dept. of Transportation, Augusta.
DETECTION AND MONITORING VEGETATION DAMAGE ASSOCIATED WITH HIGHWAYS AND HIGHWAY FACILITIES Progress Report
Ernest G. Stoeckeler, Principal Investigator 1 Jan. 1973 2 p
(Contract NAS5-21724)
(E72-10371; NASA-CR-129829; PR-4) Avail: NTIS HC \$3.00 CSCL 08F

02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

N73-14365* California Univ., Berkeley. Forestry Remote Sensing Lab.
REMOTE SENSING DATA AS AN AID TO RESOURCE MANAGEMENT IN NORTHERN CALIFORNIA
In its An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Techniques 1 May 1972 123 p
 refs Original contains color illustrations

CSSL 08F

The usefulness of remote sensing data in providing general land use planning information concerning the coastal zone of northern California is evaluated. The degree to which physical land features can be extracted from remote sensing data by human interpretation or automatic methods is determined.

E.H.W.

N73-14367* California Univ., Santa Barbara. Dept. of Geography.
ASSESSMENT OF THE IMPACT OF THE CALIFORNIA WATER PROJECT ON THE WEST SIDE OF THE SAN JOAQUIN VALLEY

John E. Estes *In its* An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Techniques 1 May 1972 38 p Original contains color illustrations

CSSL 08H

Changes in the regional scale parameters used to characterize the nature of area transformation caused by the California State Water Project are analyzed. Data were taken from Mission 164 and ERTS high flight simulation imagery. Indicators considered cover general and urban oriented land use, general and problem oriented vegetation, irrigation systems, and identification of crops.

E.H.W.

N73-14368* California Univ., Riverside. Dept. of Geography
ASSESSMENT OF THE IMPACT OF THE CALIFORNIA WATER PROJECT IN SOUTHERN CALIFORNIA

Leonard W. Bowden *In its* An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Techniques 1 May 1972 70 p refs Original contains color illustrations

CSSL 08H

Investigations were made of remotely sensed data applications that contribute to an understanding of the southern California environment and its resources. The development of equipment and methodologies for geographic information systems, as well as preparation of a data base for analyzing the impact of the California State Water Project on land use and development, are examined.

E.H.W.

N73-14876# Environmental Measurements, Inc., San Francisco, Calif.

SO2 AND NO2 MEASUREMENTS: SOUTHERN CALIFORNIA, 18-22 OCTOBER 1971

Dec. 1971 29 p

(Contract EPA-6H-02-0124)

(PB-210717; APTD-1147) Avail: NTIS HC \$3.00 CSSL 13B

Independent remote sensing data were desired for comparisons to final acceptance tests of infrared remote sensors. A dual-gas correlation spectrometer was used to measure sulfur dioxide and nitrogen dioxide simultaneously. Perimeter measurements were made in the general vicinity of an industrial area in Southern California. Next a comparison was made between the COSPEC 2 correlation spectrometer and the COSPEC 3 version.

GRA

N73-14942* Mississippi State Univ., State College. Flight Data Statistics Office.

SMOKE PLUME ANALYSIS USING FAN-BEAM AND SINGLE-BEAM RADIOMETERS

Jimmy L. Dodd *In* Auburn Univ. The NASA-ASEE Summer Fac. Fellowship Program Sep. 1972 p 65-73 refs

CSSL 14B

N73-14948* East Tennessee State Univ., Johnson City.
THE PROSPECTS OF UTILIZING REMOTELY SENSED DATA IN THE PREPARATION OF ENVIRONMENTAL-SOCIOLOGICAL MODELS

Robert B. Honea *In* Auburn Univ. The NASA-ASEE Summer Fac. Fellowship Program Sep. 1972 p 279-315 refs

CSSL 05K

N73-15339# Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.

ECOLOGICAL EFFECTS OF STRIP MINING IN OHIO
Bi-monthly Progress Report, 1 Nov. 1972 - 1 Jan. 1973

Phillip Chase, Principal Investigator 1 Jan. 1973 5 p

(Contract NAS5-21762)

(E73-10003; NASA-CR-129927; Rept-73-141-079) Avail: NTIS HC \$3.00 CSSL 08I

The author has identified the following significant results. One result significant as a practical application and for cost benefit analysis is the relative ease with which ERTS-1 will monitor new and unclaimed stripping activities in Southeastern Ohio and in all of Appalachia. Band 5 resolution appears to be better than the often reported 80 meters. The strip mines stand out well enough to be easily identified without other graphic aids. Standing water within the strip mined area stands out in either bands 6 or 7. Areas of several acres are visible. Significant increases in surface extent of water of stripped areas should be detectable on a comparative basis. The degree of reclamation is observable in the imagery in rather gross percentage steps and for areas larger than the bare earth sizes in the table. The gradation in tones in the different bands indicates that probability density imagery using the four bands in CCT data (and statistical processing) is likely to separate degrees of vegetative reclamation.

N73-15344# Oregon State Univ., Corvallis.

COMPARATIVE EVALUATION OF ERTS-A IMAGERY FOR RESOURCE INVENTORY IN LAND USE PLANNING Progress Report, period ending 31 Dec. 1972

Gerald H. Simonson, Principal Investigator 10 Jan. 1973 22 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(Contract NAS5-21831)

(E73-10008; NASA-CR-129932) Avail: NTIS HC \$3.25 CSSL 08F

There are no author-identified significant results in this report. Evaluation has begun on ERTS-1 imagery of Crook County for use in landform interpretation and geologic mapping and interpretation. Outside of Crook County the geology team has been impressed by the display of fault patterns in southeastern Oregon and has begun preliminary analyses of these. Using the color combiner a complete timber type map of (1) all the forest land within Crook County, and (2) all the Ochoco National Forest has been completed. The timber types consist of five density classes which are correlated with different species compositions as the first step in the multistage forest inventory. Using the ERTS magnetic tape data the computer center has produced a 12 by 25 mile strip printout of bands 5, 6, and 7. The computer printouts are to be analyzed for different timber types and possible insect damage. Other results are: (1) limited number of clearcuts in eastern Oregon and in Cascades evident; (2) positive transparencies of band 5 appear to be too dark for maximum information of forested areas; and (3) much more information in the computer printouts of bands 6 and 7, than 5, when analyzing forest conditions.

A.L.

N73-15350# Maine Dept. of Transportation, Augusta. Materials and Research Div.

TO DEVELOP A LAND USE PEAK RUNOFF CLASSIFICATION SYSTEM FOR HIGHWAY ENGINEERING PURPOSES Interim Report, Jun. - Dec. 1972

Ernest G. Stoeckeler, Principal Investigator 30 Dec. 1972 6 p (Contract NAS5-21724)

(E73-10014; NASA-CR-129940) Avail: NTIS HC \$3.00 CSSL 08M

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The author has identified the following significant results. Bands 6 and 7 are excellent for the detection of surficial water and swampy sites having the water table at or near the ground surface. Water bodies less than five acres in extent have been identified. Color composites should provide considerably more data for visual analysis than the black and white products currently available to this investigation.

N73-15358*# Cornell Univ., Ithaca, N.Y. New York State Coll. of Agriculture.

APPLICATION OF ERTS IMAGERY TO INVESTIGATING LAND USE AND NATURAL RESOURCES Progress Report, 13 Dec. 1972 - 13 Jan. 1973

Ernest E. Hardy, Principal Investigator 13 Jan. 1973 4 p (Contract NAS5-21886)

(E73-10024; NASA-CR-129954) Avail: NTIS HC \$3.00 CSCL 08F

N73-15365*# State of Ohio Dept. of Development, Columbus. **RELEVANCE OF ERTS-1 TO THE STATE OF OHIO** Semiannual Progress Report, Jul. - Dec. 1972

David C. Sweet, Principal Investigator, T. L. Wells, and G. E. Wukelic 15 Jan. 1973 41 p Prepared for Battelle Columbus Labs. Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(Contracts NAS5-21782; BCL-72-17/G-1793)

(E73-10032; NASA-CR-129985; SAPR-1) Avail: NTIS HC \$4.25 CSCL 08F

The author has identified the following significant results. To date, only one significant result has been reported for the Ohio ERTS program. This result relates to the proven usefulness of ERTS-1 imagery for mapping and inventorying strip-mined areas in southeastern Ohio. ERTS provides a tool for rapidly and economically acquiring an up-to-date inventory of strip-mined lands for state planning purposes which was not previously possible.

N73-15367*# Geological Survey, Washington, D.C. Geographic Applications Program.

A PRELIMINARY EVALUATION OF LAND USE MAPPING AND CHANGE DETECTION CAPABILITIES USING AN ERTS IMAGE COVERING A PORTION OF THE CARETS REGION Progress Report

Katherine A. Fitzpatrick and Harry F. Lins, Jr. Dec. 1972 13 p ref Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(NASA Order S-70243-AG-3)

(E73-10034; NASA-CR-129987; USGS-DO-73-001;

GAP-ETR-3) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. A preliminary study on the capabilities of ERTS data in land use mapping and change detection was carried out in the area around Frederick County, Maryland, which lies in the northwest corner of the Central Atlantic Regional Ecological Test Site. The investigation has revealed that Level 1 (of the Anderson classification system) land use mapping can be performed and that, in some cases, land undergoing change can be identified. Results to date suggest that more work should be done in areas where land use changes are known to exist, in order to establish some form of base for recognizing the spectral signature indicative of change areas.

N73-15473*# Iowa Univ., Iowa City. Inst. of Urban and Regional Research.

THE APPLICATION OF REMOTE SENSING TECHNIQUES TO INTER AND INTRA URBAN ANALYSIS Final Report

Frank E. Horton May 1972 253 p refs

(NASA Order W-13185; USGS-14-08-0001-12505)

(NASA-CR-130290; USGS-IR-NASA-250; USGS-DO-73-002) Avail: NTIS HC \$14.75 CSCL 14E

This is an effort to assess the applicability of air and spaceborne photography toward providing data inputs to urban and regional planning, management, and research. Through evaluation of remote sensing inputs to urban change detection systems, analyzing an effort to replicate an existing urban land use data file using remotely sensed data, estimating population and dwelling units from imagery, and by identifying and evaluating a system of urban places utilizing space photography, it was determined that remote sensing can provide data concerning land use, changes in commercial structure, data for transportation planning, housing quality, residential dynamics, and population density. Author

N73-15965# Joint Publications Research Service, Arlington, Va.

TRANSLATIONS ON EASTERN EUROPE: SCIENTIFIC AFFAIRS, NO. 290

18 Dec. 1972 24 p refs Transl. into ENGLISH from various Eastern European publications

(JPRS-67792) Avail: NTIS HC \$3.25

Articles are presented concerning the role and activities of the Hungarian National Bureau of Metrology and the use of photogrammetry in city planning and modernization.

N73-15967 Joint Publications Research Service, Arlington, Va. **PHOTOGRAMMETRY IN CITY PLANNING AND MODERNIZATION** c14

G. Anculete In its Transl. on Eastern Europe: Sci. Affairs, No. 290 18 Dec. 1972 p 13-21 refs Transl. into ENGLISH from Terra (Bucharest), no. 5, Sep. - Oct. 1972 p 10-18

The role of aerial photography and photogrammetry in urban planning are discussed along with other equally modern techniques which are now being utilized. The technologies involved and the areas of application are dealt with as well as the benefits to be derived. It is pointed out that, if the information offered by photogrammetry and the other auxiliary techniques of remote detection are transposed into maps or transparent graphs, we can more realistically deduce the modernization deficiencies of our cities and arrive at practical solutions. D.L.G.

N73-16060*# West Florida Univ., Pensacola.

THE USE OF REMOTE SENSORS TO RELATE BIOLOGICAL AND PHYSICAL INDICATORS TO ENVIRONMENTAL AND PUBLIC HEALTH PROBLEMS

Sep. 1972 182 p refs

(Contract NAS9-11872)

(NASA-CR-128727) Avail: NTIS HC \$11.25 CSCL 14B

Relationships between biological, ecological and botanical structures, and disease organisms and their vectors which might be detected and measured by remote sensing are determined. In addition to the use of trees as indicators of disease or potential disease, an attempt is made to identify environmental factors such as soil moisture and soil and water temperatures as they relate to disease or health problems and may be detected by remote sensing. The following three diseases and one major health problem are examined: Malaria, Rocky Mountain spotted fever, Encephalitis and Red Tide. It is shown that no single species of vascular plant nor any one environmental factor can be used as the indicator of disease or health problems. Entire vegetation types, successional stages and combinations of factors must be used. Author

N73-16298 Kansas Univ., Lawrence.

THE DISCRIMINATION OF TROPICAL LAND USE IN PUERTO RICO: AN ANALYSIS USING MULTISPECTRAL IMAGERY Ph.D. Thesis

Roland Deloy Mower 1971 233 p

Avail: Univ. Microfilms Order No. 72-1181

This study evaluated various types of multispectral remote sensor imagery to assess their usefulness for discriminating and mapping land use categories found in a tropical environment. Several related problems were analyzed: (1) Determine if existing land use categories were applicable to remote sensor imagery.

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(2) Determine if unique or redundant data were acquired by the various channels of the remote sensor system. (3) Determine if land use categories could be correctly discriminated at the 90 percent level. (4) Determine if additional data improved discrimination decisions. (5) Determine if certain channels or combinations were better land use discriminators than others. (6) Determine if automated imagery interpretation was more or less reliable than human interpretation. Ten gross land use categories were identified in Puerto Rico, which was selected as the test region. Overall, the multiband channels provided the best discrimination of land use categories in the Puerto Rican test region.

Dissert. Abstr.

N73-16301* Tri-State Regional Planning Commission, New York.

INVESTIGATION OF SATELLITE IMAGERY FOR REGIONAL PLANNING Progress Report

William Harting, Principal Investigator 29 Dec. 1972 1 p (Contract NAS5-21738)

(E73-10038; NASA-CR-130285; PR-1) Avail: NTIS HC \$3.00 CSCL 08F

N73-16303* Tennessee Univ., Knoxville. Dept. of Geography. GEOGRAPHIC APPLICATIONS OF ERTS-1 IMAGERY TO RURAL LANDSCAPE CHANGE IN EASTERN TENNESSEE

John B. Rehder, Principal Investigator and James R. OMalley 30 Jan. 1973 23 p Proposed for presentation at 2d Ann. Remote Sensing of Earth Resources Conf., Tullahoma, Tenn., 26-27 Mar. 1973 Submitted for publication Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 (Contract NAS5-21726)

(E73-10040; NASA-CR-130319) Avail: NTIS HC \$3.25 CSCL 08F

There are no author-identified significant results in this report. A multistage sampling experiment was conducted using low (10,000') and high (60,000') altitude aircraft imagery in comparison with orbital (560 miles) ERTS imagery. Although the aircraft data provide detailed landscape observations similar to ground truth data, they cover relatively small areas per image frame for irregular static slices of time. By comparison, ERTS provides repetitive observations in a regional perspective for broad areal coverage. Microdensitometric and computer techniques are being used to analyze the ERTS imagery for gray tone signatures, comparisons, and ultimately for landscape change detection.

N73-16324* Bureau of Reclamation, Denver, Colo. APPLICATION OF REMOTE SENSING TO SELECTED BUREAU OF RECLAMATION PROJECTS Progress Report, 1 Nov. - 31 Dec. 1972

Larry D. Cast, Principal Investigator 29 Dec. 1972 2 p (NASA Order S-70243-AG)

(E73-10062; NASA-CR-130312) Avail: NTIS HC \$3.00 CSCL 05B

N73-16326* Geological Survey, Washington, D.C. Geographic Applications Program.

CENSUS CITIES EXPERIMENT IN URBAN CHANGE DETECTION Progress Report, 1 Jul. - 31 Dec. 1972

James R. Wray, Principal Investigator 1 Jan. 1973 8 p (NASA Order S-70243-AG)

(E73-10064; NASA-CR-130314) Avail: NTIS HC \$3.00 CSCL 05K

The author has identified the following significant results. Work continues on mapping of 1970 urban land use from 1970 census contemporaneous aircraft photography. In addition, change detection analysis from 1972 aircraft photography is underway for several urban test sites. Land use maps, mosaics, and census overlays for the two largest urban test sites are nearing publication readiness. Preliminary examinations of ERTS-1 imagery of San Francisco Bay have been conducted which show that tracts of land of more than 10 acres in size which are undergoing development in an urban setting can be identified. In addition,

each spectral band is being evaluated as to its utility for urban analyses. It has been found that MSS infrared band 7 helps to differentiate intra-urban land use details not found in other MSS bands or in the RBV coverage of the same scene. Good quality false CIR composites have been generated from 9 x 9 inch positive MSS bands using the Diazo process.

N73-16328* Bureau of Reclamation, Denver, Colo.

APPLICATION OF REMOTE SENSING TO SELECTED BUREAU OF RECLAMATION PROJECTS Progress Report, 1 Jul. - 31 Dec. 1972

Larry D. Cast, Principal Investigator 1 Jan. 1973 3 p (NASA Order S-70243-AG)

(E73-10066; NASA-CR-130316) Avail: NTIS HC \$3.00 CSCL 05B

N73-16329* Geological Survey, Washington, D.C.

UTILIZATION OF ERTS-1 GENERATED PHOTOGRAPHS IN THE EVALUATION OF THE IRANIAN PLAYAS AS POTENTIAL LOCATIONS FOR ECONOMIC AND ENGINEERING DEVELOPMENT Progress Report, 1 Jul. - 31 Dec. 1972

Daniel B. Krinsley, Principal Investigator 1 Jan. 1973 4 p (NASA Order S-70243-AG)

(E73-10067; NASA-CR-130317) Avail: NTIS HC \$3.00 CSCL 08H

N73-16334* Mississippi State Univ., State College.

STUDY OF APPLICATION OF REMOTE SENSING DATA TO LAND USE PLANNING ON THE MISSISSIPPI GULF COAST Interim Report, Sep. 1972 - Jan. 1973

Franklin M. Ingels, Principal Investigator and Robert W. Boyd Feb. 1973 15 p (Contract NAS5-21817)

(E73-10072; NASA-CR-130013) Avail: NTIS HC \$3.00 CSCL 08C

There are no author-identified significant results in this report. Comparisons are being developed for ERTS-1 imagery and data from existing land use studies of the four county area of the Mississippi Gulf Coast. ERTS-1 data will be analyzed by computer programs and land use maps will be produced which delineate categories of interest. These computer produced products will be analyzed to determine accuracy and suitability of the data for land use planning compared to the present means of data collection for such studies.

N73-16357* National Oceanic and Atmospheric Administration, Washington, D.C.

ENVIRONMENTAL MONITORING BY REMOTE SENSING FROM AIR TO SPACE

William O. Davis / In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 1 1972 p 107-118

CSCL 04A

The use of remote sensors to measure and observe all elements of the environment over the entire surface of the earth is discussed. The three areas of interest are identified as (1) short term effects which endanger life and property, (2) prediction of environmental changes, and (3) identification and management of the resources of the atmosphere, oceans, lakes, rivers, and land. Examples of aerial photography are included to show the services available for weather analysis. An example of ocean temperature distribution, as determined by Nimbus infrared sensors is presented. A schematic diagram for the organization and functions of a solar activity forecasting service is illustrated.

P.N.F.

N73-16358* Geological Survey, Washington, D.C.

REMOTE SENSING OF ENVIRONMENTAL QUALITY

Gary W. North / In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 1 1972 p 119-129

CSCL 04A

A series of steps and procedures to show how remote sensing can be used to conduct regional environmental quality are defined.

02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

The objectives to be accomplished by remote sensing of environmental quality are outlined. Multispectral scanner imagery examples of various cultural features are provided. The use of remote sensors to detect water pollution and changes in water conditions is reported. Aerial photographs are provided to amplify the text. P.N.F.

N73-16392* Florida Univ., Gainesville.

REGIONAL LAND USE MAPPING: THE PHOENIX PILOT PROJECT

James R. Anderson and John L. Place (Geol. Surv.) /in NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 2 1971 p 196-210 refs

CSSL 08B

The Phoenix Pilot Program has been designed to make effective use of past experience in making land use maps and collecting land use information. Conclusions reached from the project are: (1) Land use maps and accompanying statistical information of reasonable accuracy and quality can be compiled at a scale of 1:250,000 from orbital imagery. (2) Orbital imagery used in conjunction with other sources of information when available can significantly enhance the collection and analysis of land use information. (3) Orbital imagery combined with modern computer technology will help resolve the problem of obtaining land use data quickly and on a regular basis, which will greatly enhance the usefulness of such data in regional planning, land management, and other applied programs. (4) Agreement on a framework or scheme of land use classification for use with orbital imagery will be necessary for effective use of land use data. Author

N73-16393* Iowa Univ., Iowa City. Inst. of Urban and Regional Research.

THE APPLICATION OF REMOTE SENSING TECHNIQUES TO URBAN DATA ACQUISITION

Frank E. Horton /in NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 2 1971 p 212-223 refs

CSSL 05K

The application of remote sensing techniques useful in acquiring data concerning housing quality is discussed. Conclusions reached from the investigation were: (1) Use of individuals with a higher degree of training in photointerpretation should significantly increase the percentage of successful classifications. (2) Small area classification of urban housing quality can definitely be accomplished via high resolution aerial photography. Such surveys, at the levels of accuracy demonstrated, can be of major utility in quick look surveys. (3) Survey costs should be significantly reduced. A.L.

N73-16394* California Univ., Riverside. Dept. of Geography.

CLIMATOLOGY OF URBAN-REGIONAL SYSTEMS

Robert W. Pease /in NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 2 1971 p 224-240 refs

CSSL 04B

Urbanized areas have come to be significant if not dominant components of many regional land surfaces. They represent perhaps the most dramatic recent change man has made in his environment - a change that may well burgeon in the foreseeable future as greater percentages of world populations crowd into metropolitan areas. The climate of urban-regional systems is involved because temperature, air, and pollutants added to the air are significant aspects of this change. During the past two years, substantial progress has been made in the application of remote sensing techniques to the study of urban climatology by programs jointly sponsored by NASA and the United States Geological Survey. The initial effort has endeavored with considerable success to map terrestrial radiation emission or the general thermal state of the land surface with the aid of imaging radiometers (mechanical-optical scanners). Author

N73-16395* Geological Survey, Washington, D.C.

CENSUS CITIES PROJECT AND ATLAS OF URBAN AND REGIONAL CHANGE

James R. Wray /in NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 2 1971 p 242-259

CSSL 05K

The Census Cities Project has several related purposes: (1) to assess the role of remote sensors on high altitude platforms for the comparative study of urban areas; (2) to detect changes in selected U.S. urban areas between the 1970 census and the time of launching of an earth-orbiting sensor platform prior to the next census; (3) to test the utility of the satellite sensor platform to monitor urban change (When the 1970 census returns become available for small areas, they will serve as a control for sensor image interpretation.); (4) to design an information system for incorporating graphic sensor data with census-type data gathered by traditional techniques; (5) to identify and design user-oriented end-products or information services; and (6) to plan an effective organizational capability to provide such services on a continuing basis. Author

N73-16397* Geological Survey, Washington, D.C.

REMOTE SENSING OF ENVIRONMENTAL POLLUTION

Gary W. North /in NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 2 1971 p 290-301

CSSL 04A

Environmental pollution is a problem of international scope and concern. It can be subdivided into problems relating to water, air, or land pollution. Many of the problems in these three categories lend themselves to study and possible solution by remote sensing. Through the use of remote sensing systems and techniques, it is possible to detect and monitor, and in some cases, identify, measure, and study the effects of various environmental pollutants. As a guide for making decisions regarding the use of remote sensors for pollution studies, a special five-dimensional sensor/applications matrix has been designed. The matrix defines an environmental goal, ranks the various remote sensing objectives in terms of their ability to assist in solving environmental problems, lists the environmental problems, ranks the sensors that can be used for collecting data on each problem, and finally ranks the sensor platform options that are currently available. Author

N73-16398* TRW Systems Group, Redondo Beach, Calif.

REMOTE SENSING OF WATER POLLUTION

Peter G. White /in NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 2 1971 p 302-321

CSSL 08H

Remote sensing, as a tool to aid in the control of water pollution, offers a means of making rapid, economical surveys of areas that are relatively inaccessible on the ground. At the same time, it offers the only practical means of mapping pollution patterns that cover large areas. Detection of oil slicks, thermal pollution, sewage, and algae are discussed. Author

N73-16423*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

ADP OF MULTISPECTRAL SCANNER DATA FOR LAND USE MAPPING

Roger M. Hoffer [1971] 26 p refs

(Grant NGL-15-005-112)

(NASA-CR-130372; LARS-Info-Note-080372) Avail: NTIS HC \$3.50 CSSL 08B

The advantages and disadvantages of various remote sensing instrumentation and analysis techniques are reviewed. The use of multispectral scanner data and the automatic data processing techniques are considered. A computer-aided analysis system for remote sensor data is described with emphasis on the image display, statistics processor, wavelength band selection, classification processor, and results display. Advanced techniques in using spectral and temporal data are also considered. N.E.N.

N73-16437*# Grumman Aerospace Corp., Bethpage, N.Y. Research Dept.

WATER QUALITY DETERMINATIONS IN THE VIRGIN ISLANDS FROM ERTS-A DATA

W. Egan Dec. 1972 26 p refs Presented at 8th Intern. Symp. on Remote Sensing of Environment, Ann Arbor, Mich., Oct. 1972 Sponsored by NASA (NASA-CR-130008; RM-561J) Avail: NTIS HC \$3.50 CSCL 08H

The harbor at Charlotte Amalie on St. Thomas, Virgin Islands, has a concentration of many factors affecting water quality: untreated sewage effluent, sediment from navigation and dredging operations, runoff from a garbage dump, and hot effluent from a desalination/power plant. Imagery from ERTS-A in association with aircraft imagery and ground truth permits the characterization of water quality in terms of absolute color values. This necessitates the establishment of photometric standards resolvable by the ERTS-A sensors in order that atmospheric effects, which generally vary on sequential overpasses, may be determined and subtracted. The over-all program is described together with typical numerical results. Author

N73-17290# Wisconsin Univ., Madison. EVALUATION OF THE APPLICATION OF ERTS-1 DATA TO THE REGIONAL LAND USE PLANNING PROCESS Progress Report, period ending 1 Feb. 1973

James L. Clapp, Principal Investigator 1 Feb. 1973 24 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(Contract NAS5-21754) (E73-10077; NASA-CR-130023) Avail: NTIS HC \$3.25 CSCL 08M

N73-17293# Earth Satellite Corp., Washington, D.C. INVESTIGATION OF APPLICATION OF ERTS-A DATA TO INTEGRATED STATE PLANNING IN MARYLAND Progress Report, period ending 31 Jan. 1972

Edwin L. Thomas, Principal Investigator 2 Feb. 1973 8 p Prepared for Md. Dept. of State Planning (Contract NAS5-21779)

(E73-10081; NASA-CR-130279; PR-3) Avail: NTIS HC \$3.00 CSCL 05C

N73-17295# Brevard County Planning Dept., Titusville, Fla. URBAN AND REGIONAL PLANNING PROPOSAL NO. Y-10-033-001 Progress Report, 1 Sep. 1972 - 31 Jan. 1973 John W. Hannah and Garland L. Thomas, Principal Investigators 31 Jan. 1973 21 p

(Contract NAS5-21847) (E73-10083; NASA-CR-130281) Avail: NTIS HC \$3.25 CSCL 05K

There are no author-identified significant results in this report. A program has been completed to print out the radiance values for any specified combination of the four MSS bands for a specified sector of an image. A program to map intensities for any band is being written. An investigation of the characteristics of cities in the Brevard County area, as seen by ERTS-1, has been started. Investigation has not been completed; however, results initially obtained are presented. A Digilog viewer was used to determine the relative reflectance of cities (and other developed sectors) in the area. This was done by a combination of two methods: (1) varying the offset control so that the brightest spot appeared first, followed by the second brightest spot; and (2) reading the relative light transmissions at selected positions. A band 5 image was used and the results, in order of maximum reflectance apparent within the sector, are given. A.L.

N73-17302# Geological Survey, Washington, D.C. LAND USE MAPPING AND MODELLING FOR THE PHOENIX QUADRANGLE Progress Report, 1 Jul. - 31 Dec. 1972

John L. Place, Principal Investigator 1 Jan. 1973 9 p (NASA Order S-70243-AG) (E73-10090; NASA-CR-130339) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. The land use of the Phoenix Quadrangle in Arizona had been mapped previously from aerial photographs and recorded in a

computer data bank. During the ERTS experiment, changes in land use were detected, first with the ERTS-simulation photographs, then with the ERTS-1 images when they became available. In each case, the I2S color additive viewer was used as the primary image enhancement tool, operated in a multispectral mode. A search was made for a method of creating hard copy color composite images of the best combinations of multiband composites from ERTS-1, mostly by photographic and diazo processes. The I2S viewer was also used to enhance changes between successive images by quick flip techniques or by registering with different color filters. Improved interpretation of land use change resulted, and a map of changes in the Phoenix Quadrangle was compiled using magnified ERTS-1 images alone. The first level of a standard land use classification system was successfully used. Between the ERTS-1 images for August and November, some differences were detected that could be caused by seasonal characteristics of vegetation or by change in use.

N73-17310# Maine Dept. of Transportation, Augusta. TO DEVELOP A LAND USE PEAK RUNOFF CLASSIFICATION SYSTEM FOR HIGHWAY ENGINEERING PURPOSES Progress Report

Ernest G. Stoeckeler, Principal Investigator 1 Feb. 1973 2 p (Contract NAS5-21772) (E73-10100; NASA-CR-130528; PR-4) Avail: NTIS HC \$3.00 CSCL 08B

N73-17495# Earth Satellite Corp., Berkeley, Calif. A SCHEME FOR THE UNIFORM MAPPING AND MONITORING OF EARTH RESOURCES AND ENVIRONMENTAL COMPLEXES USING ERTS-1 IMAGERY Progress Report, 1 Jul. - 31 Dec. 1972

Charles E. Poulton, Principal Investigator and Robin I. Welch 31 Jan. 1973 29 p (Contract NAS5-21830)

(E73-10289; NASA-CR-130572; PR-1) Avail: NTIS HC \$3.50 CSCL 08B

There are no author-identified significant results in this report. Progress on plans for the development and testing of a practical procedure and system for the uniform mapping and monitoring of natural ecosystems and environmental complexes from space-acquired imagery is discussed. With primary emphasis on ERTS-1 imagery, but supported by appropriate aircraft photography as necessary, the objectives are to accomplish the following: (1) Develop and test in a few selected sites and areas of the western United States a standard format for an ecological and land use legend for making natural resource inventories on a simulated global basis. (2) Based on these same limited geographic areas, identify the potentialities and limitations of the legend concept for the recognition and annotation of ecological analogs and environmental complexes. An additional objective is to determine the optimum combination of space photography, aerial photography, ground data, human data analysis, and automatic data analysis for estimating crop yield in the rice growing areas of California and Louisiana. A.L.

N73-17514# Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div. REMOTE SENSING IN MICHIGAN FOR LAND RESOURCE MANAGEMENT Annual Report, 1972

I. J. Sattinger Dec. 1972 49 p refs Prepared in cooperation with Mich. State Univ. Original contains color illustrations (Contract NSR-23-005-527)

(NASA-CR-130758; Rept-190800-2-F) Avail: NTIS HC \$4.50 CSCL 08F

This project to demonstrate the application of earth resource survey technology to current problems in Michigan was undertaken jointly by the Environmental Research Institute of Michigan and Michigan State University. Remote sensing techniques were employed to advantage in providing management information for the Pointe Mouillee State Game Area and preparing an impact assessment in advance of the projected construction of the M-14 freeway from Ann Arbor to Plymouth, Michigan. The project also assisted the state government in its current effort to develop and implement a state-wide land management plan. Author

02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

N73-17515* Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.
REMOTE SENSING IN MICHIGAN FOR LAND RESOURCE MANAGEMENT: HIGHWAY IMPACT ASSESSMENT
 Dec. 1972 118 p refs Prepared in cooperation with Michigan State Univ. and Michigan Dept. of State Highways
 (Grant NSR-23-005-527)
 (NASA-CR-130761; Rept-190800-1-T) Avail: NTIS HC \$8.00 CSCL 08F

An existing section of M-14 freeway constructed in 1964 and a potential extension from Ann Arbor to Plymouth, Michigan provided an opportunity for investigating the potential uses of remote sensing techniques in providing projective information needed for assessing the impact of highway construction. Remote sensing data included multispectral scanner imagery and aerial photography. Only minor effects on vegetation, soils, and land use were found to have occurred in the existing corridor. Adverse changes expected to take place in the corridor proposed for extension of the freeway can be minimized by proper design of drainage ditches and attention to good construction practices. Remote sensing can be used to collect and present many types of data useful for highway impact assessment on land use, vegetation categories and species, soil properties and hydrologic characteristics. Author

N73-17516* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
LAND USE CLASSIFICATION UTILIZING REMOTE MULTISPECTRAL SCANNER DATA AND COMPUTER ANALYSIS TECHNIQUES
 P. N. LeBlanc, C. J. Johannsen, and J. E. Yanner [1973] 109 p refs
 (Grant NGL-15-005-112)
 (NASA-CR-130759; LARS-111672) Avail: NTIS HC \$7.50 CSCL 08M

An airborne multispectral scanner was used to collect the visible and reflective infrared data. A small subdivision near Lafayette, Indiana was selected as the test site for the urban land use study. Multispectral scanner data were collected over the subdivision on May 1, 1970 from an altitude of 915 meters. The data were collected in twelve wavelength bands from 0.40 to 1.00 micrometers by the scanner. The results indicated that computer analysis of multispectral data can be very accurate in classifying and estimating the natural and man-made materials that characterize land uses in an urban scene. Author

N73-17517* Tennessee Univ., Knoxville.
APPLICATION OF REMOTE SENSING TECHNIQUES TO MEASUREMENT OF USE OF OUTDOOR RECREATION RESOURCES
 Kerry F. Schell and Joe H. Taft Sep. 1972 114 p refs
 Sponsored in part by NASA
 (Contract BOR-2-14-02-1)
 (NASA-CR-130752; USGS-IR-NASA-256; PB-214638; USGS-DO-73-004) Avail: NTIS HC \$7.75 CSCL 05K

This study attempts to determine if remote sensing techniques are available which would measure directly the number of individuals engaged in a specific outdoor recreation activity at a specific time. Airborne sensors received the most attention after initial study of satellite and high-altitude aircraft systems showed they offer no promise at this time for measuring recreation use. The DINADE-type system probably has more potential than any other system encountered, however, the development costs for this single purpose could be prohibitive. Efforts to improve ground-based methods such as time-lapse or activated photography could supply virtually constant monitoring, an attribute thus far not achieved. Author

N73-17525* National Swedish Inst. for Building Research, Stockholm.
A SYSTEM OF DESCRIBING AND CLASSIFYING INFORMATION CONCERNING LAND FORMS
 Sven G. Moller 1972 81 p
 (PB-212774; D8:1972; ISBN-91-540-2041-7) Avail: NTIS HC \$3.00; Svensk Byggtjänst, Box 1403, S-1-11 84, Stockholm, Sweden; Sw.Kr. 18 CSCL 08G

All planning of a landscape for some purpose such as community development of agriculture-forestry is preceded by and based on an inventory at three strata of the information relating to the landscape, physical geography, urban geography and present land use. The future land use is studied and laid down in the plan. The report contains an account of an outline system for the description and classification of the natural and the cultural landscape as a step in the formulation of a Swedish system of aerial photographic interpretation. GRA

N73-17535* Rome Air Development Center, Griffiss AFB, N.Y.
COMPUTER ANALYSIS OF MULTISPECTRAL IMAGE DENSITIES TO CLASSIFY LAND USES
 James D. Turinetti, III Sep. 1972 163 p refs
 (AD-752217; RADCR-72-237) Avail: NTIS CSCL 08/6

The paper discusses an investigation into the computerized analysis of the combined application of day and night thermal infrared imagery with color film; and day and night thermal infrared imagery with bands of multispectral imagery. This study looked at the pairing of: (1) Day and Night Thermal Infrared (TIR); (2) Day and Night TIR with Color Infrared film; (3) Day and Night TIR with those channels of the Multispectral system which covered the same portion of the spectrum that is covered by Color film; (4) Day and Night TIR with those channels of the Multispectral system which covered the same portion of the spectrum that is covered on Color Infrared film; and (5) Day and Night TIR with all eight channels of the Multispectral system. The image densities for selected known landuse classes were processed through a Fortran program and used as a model for identifying sample targets of known landuse classes. Author (GRA)

N73-17682* General Dynamics/Astronautics, San Diego, Calif. Aerospace Div.
MONITORING OF AIR POLLUTION BY SATELLITES (MAPS), PHASE 1 Final Report, 21 Sep. 1971 - 20 Mar. 1972
 C. B. Ludwig, W. Malkmus, M. Griggs, and E. R. Bartle Apr. 1972 195 p refs
 (Contract NAS1-11111)
 (NASA-CR-112137; GDCA-HAB-73-005) Avail: NTIS HC \$11.75 CSCL 04B

Results are reported upon which the design of a satellite remote gas filter correlation (RGFC) instrument can be based. Although a final decision about the feasibility of measuring some of the pollutants with the required accuracy is still outstanding and subject to further theoretical and experimental verifications, viable concepts are presented which permit the initiation of the design phase. The pollutants which are of concern in the troposphere and stratosphere were selected. The infrared bands of these pollutants were identified, together with the bands of interfering gases, and the line parameters of the pollutants as well as interfering gases were generated through a computer program. Radiative transfer calculations (line-by-line) were made to establish the radiation levels at the top of the atmosphere and the signal levels at the detector of the RGFC instrument. Based upon these results the channels for the RGFC were selected. Finally, the problem areas, which need further investigations, were delineated and the supporting data requirements were established. Author

N73-18328* Science Applications, Inc., La Jolla, Calif.
DETERMINATION OF AEROSOL CONTENT IN THE ATMOSPHERE FROM ERTS-1 DATA Progress Report, 7 Jan. 1972 - 6 Mar. 1973
 C. B. Ludwig, Principal Investigator and M. Griggs 7 Mar. 1973 7 p
 (Contract NAS5-21860)
 (E73-10295; NASA-CR-130384; SAI-73-516-LJ; PR-3) Avail: NTIS HC \$3.00 CSCL 04A

N73-18331* Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.
UTILIZATION OF ERTS-1 DATA TO MONITOR AND CLASSIFY EUTROPHICATION OF INLAND LAKES Interim

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Report, Sep. 1972 - Jan. 1973

Phillip E. Chase (Cranbrook Inst. of Sci., Bloomfield Hills, Mich.) and V. Elliott Smith, Principal Investigators Feb. 1973 70 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 (Contract NAS5-21810) (E73-10299; NASA-CR-130555; BSR-4010) Avail: NTIS HC \$5.50 CSCL 08H

The author has identified the following significant results. Significant findings are: (1) one acre lakes and one acre islands are detectable; (2) circular lakes of 7.5 acres and greater reach full density; (3) long channels 100 ft wide are detectable; (4) orientation of lakes is independent of scan direction; (5) lake features are observable in enlargements of CCT imagery produced in the Bendix Earth Resources Data Center; and (6) a decision surface water outline map is presented that was produced from ERTS-1 CCT. A water color literature review, baseline water quality data of the test lakes, and a discussion of geometric corrections of the CCT decision water surface outline map are also presented.

N73-18338* Alaska Univ., Fairbanks. Inst. of Arctic Biology. **IDENTIFICATION, DEFINITION AND MAPPING OF TERRESTRIAL ECOSYSTEMS IN INTERIOR ALASKA** Progress Report, 1 Aug. 1972 - 31 Jan. 1973 J. H. Anderson, Principal Investigator 28 Feb. 1973 26 p refs (Contract NAS5-21833) (E73-10308; NASA-CR-130718) Avail: NTIS HC \$3.50 CSCL 08B

N73-18358* Pennsylvania State Univ., University Park. Office for Remote Sensing of Earth Resources. **INTERDISCIPLINARY APPLICATIONS AND INTERPRETATIONS OF ERTS DATA WITHIN THE SUSQUEHANNA RIVER BASIN: RESOURCES INVENTORY, LAND USE AND POLLUTION** Progress Report, 1 Dec. 1972 - 31 Jan. 1973 George J. McMurtry, Principal Investigator 2 Mar. 1973 31 p (Contract NAS5-23133) (E73-10327; NASA-CR-130770) Avail: NTIS HC \$3.75 CSCL 08H

The author has identified the following significant results. Identification and mapping of three major kinds of coal refuse targets based on spectral signatures in channels four through seven of the ERTS-1 MSS were conducted. Correlation of the placement of the coal refuse targets with an existing map of their location was accomplished. Digital processing of ERTS-1 data permitted identification of stripped areas including ones that are not discernible by visual analysis of ERTS imagery. Combined visual and digital techniques of analyzing ERTS-1 data for geologic formations have been tried on selected areas of Pennsylvania. Mapping of two major agriculture counties to show land forms, drainage patterns, water, and urban areas were made using positive transparencies of MSS data. Two frames of the same central Pennsylvania area were brought into registration by translation and then merged even though the frames were obtained 71 days apart. P.N.F.

N73-18361* Maine Dept. of Transportation, Augusta. **DETECTION AND MONITORING VEGETATION DAMAGE ASSOCIATED WITH HIGHWAY FACILITIES** Progress Report Ernest G. Stoekeler, Principal Investigator 1 Mar. 1973 2 p (Contract NAS5-21724) (E73-10331; NASA-CR-130774; PR-5) Avail: NTIS HC \$3.00 CSCL 02C

N73-18410* California Univ., Riverside. Dept. of Geography. **STUDIES IN REMOTE SENSING APPLICATIONS. BARRIERS TO INNOVATION: THE EXAMPLE OF REMOTE SENSING IN URBAN AND REGIONAL PLANNING IN THE LOS ANGELES METROPOLIS. INTERFACING REMOTE SENSING AND AUTOMATED GEOGRAPHIC INFORMATION SYSTEMS**

Darryl R. Roehring, Jene S. McKnight, David A. Nicholas, and William G. Brooner Sep. 1972 70 p refs (Grant NGL-05-003-404; Contract N00014-69-A-0200-5001) (NASA-CR-130989; AD-752058; TR-T-72-2; TR-T-72-3) Avail: NTIS HC \$5.50 CSCL 08B

Some items are presented in a five stage approach which are deemed necessary for employment of remote sensing and automated information systems in a land management program. The approach synthesizes research which has recently led to the development of operational systems. Author (GRA)

N73-19335* Earth Satellite Corp., Washington, D.C. **APPLICATION OF ERTS-1 DATA TO THE PROTECTION AND MANAGEMENT OF NEW JERSEY'S COASTAL ENVIRONMENT** Progress Report, period ending 28 Feb. 1973 Roland S. Yunghans, Edward B. Feinberg, and Frank J. Wobber, Principal Investigators 2 Mar. 1973 9 p Prepared for N. J. Dept. of Environ. Protect. (Contract NAS5-21765) (E73-10330; NASA-CR-130773) Avail: NTIS HC \$3.00 CSCL 08C

The author has identified the following significant results. Photomaps, using MSS bands 5 and 7, have been prepared delineating the coastal zone as described in the Coastal Area Facility Review Act before the State Legislature. An upper wetlands boundary overlay has been prepared at 1:500,000 scale. The movement and dispersion of wastes in the New York Bight area are being plotted with each orbit. The possible impact of these wastes on the New Jersey shoreline is being quantified.

N73-19338* Geological Survey, Washington, D.C. **THE UTILIZATION OF ERTS-1 GENERATED PHOTOGRAPHS IN THE EVALUATION OF THE IRANIAN PLAYAS AS POTENTIAL LOCATIONS FOR ECONOMIC AND ENGINEERING DEVELOPMENTS** Progress Report, 1 Jan. - 28 Feb. 1973 Daniel B. Krinsley, Principal Investigator 28 Feb. 1973 3 p (NASA Order S-70243-AG-3) (E73-10339; NASA-CR-130789) Avail: NTIS HC \$3.00 CSCL 08F

N73-19339* Geological Survey, Washington, D.C. **LAND USE MAPPING AND MODELLING FOR THE PHOENIX QUADRANGLE** Progress Report, 1 Jan. - 28 Feb. 1973 John L. Place, Principal Investigator 1 Mar. 1973 7 p (NASA Order S-70243-AG) (E73-10340; NASA-CR-130790) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. Comparison of 9 x 9 MSS band images and color composites made from bands 4, 5, and 6 showing vegetated areas near Phoenix during the summer and fall seasons aided in definitely establishing that certain land areas were being used as agricultural land and not as rangeland. Agricultural land, which appeared to be fallow, idle, or not irrigated, often became more readily identifiable as agricultural land when comparing different images of identical land areas which have been affected by seasonal vegetation changes. Experimentation with color density slicing portions of 9 x 9 MSS band 7 transparency showing the central urban core of Phoenix enabled dense commercial and industrial areas to be separated from less dense urbanized land uses; however, loss of resolution produced results of limited usefulness. The best results in agricultural areas near Sun City were obtained using MSS band 5 imagery. Discrimination of different land uses in both urban and agricultural areas which were color density sliced was not possible to the degree of accuracy necessary to make mapping feasible. Examination of MSS transparencies and color composites allowed updating of a map of land use change in the Phoenix Quadrangle.

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N73-19346* Geological Survey, Washington, D.C.
CENTRAL ATLANTIC REGIONAL ECOLOGICAL TEST SITE (CARETS): A PROTOTYPE REGIONAL ENVIRONMENTAL INFORMATION SYSTEM Progress Report, 1 Jul. - 31 Dec. 1972

Robert H. Alexander, Principal Investigator 1 Jan. 1973 60 p refs
(NASA Order S-70243-AG-3)
(E73-10347; NASA-CR-130806) Avail: NTIS HC \$5.00 CSCL 05B

The author has identified the following significant results. Accomplishments have included: (1) completion of the research design for the USGS/CARETS demonstration project; (2) preparation of photomosaics and land use maps at a scale of 1:100,000 for entire area; (3) demonstration of the feasibility of extracting several categories of land use information from ERTS-1 MSS data for a portion of the CARETS region; (4) demonstration of the feasibility of detecting some significant land use changes on ERTS-1 imagery; (5) demonstration of the feasibility of attaching environmental impact significance to the remote sensor-derived land use data; (6) delivery of land use information derived from high altitude aircraft data to the Maryland state planning agency for use in its statewide land use inventory; (7) demonstration of high interest by other use groups in the test region in products and services provided by investigation; and (8) determination of the viability of setting up a computerized geographic information system as part of the CARETS investigation, to facilitate handling of sensor-derived land use data in a variety of formats to suit user requirements.

N73-19348* Minnesota State Planning Agency, St. Paul.
LAND USE MANAGEMENT IN MINNESOTA Progress Report, 1 Jan. - 28 Feb. 1973

Joseph E. Sizer, Principal Investigator 28 Feb. 1973 10 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
(Contract NAS5-21801)
(E73-10352; NASA-CR-130833) Avail: NTIS HC \$3.00 CSCL 08F

N73-19371* Mitre Corp., McLean, Va.
INVESTIGATION OF ENVIRONMENTAL INDICES FROM THE EARTH RESOURCES TECHNOLOGY SATELLITE Interim Report, Aug. 1972 - Feb. 1973
Richard S. Greeley, Principal Investigator, E. L. Riley, S. Stryker, and E. A. Ward Feb. 1973 148 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
(Contract NAS5-21842)
(E73-10376; NASA-CR-131017) Avail: NTIS HC \$9.50 CSCL 08B

The author has identified the following significant results. Land use, quality, and air quality trends are being deduced from both ERTS-1 MSS and computer compatible tapes. The data analysis plan and the preliminary data analysis phase were conducted in January 1973. Results from these two phases are: (1) Method of analysis has been selected and checked out. (2) Land use for two dates have been generated for one test site. (3) Water quality for one date has been produced partially. (4) Air quality for three has been produced and compared with ground truth. (5) One of the two DCP stations is in operation; the second station will be installed in March 1973. Land use classification exceeds pre-launch expectations. Water quality (turbidity) is not progressing as expected. Finally, mesoscale air quality results have shown correlation with NOAA/EPA turbidity network. If air quality correlations continue to show favorable results, a rapid means of global turbidity may be available from ERTS-1 MSS observations.

N73-19387* Texas Univ., Houston. Inst. of Environmental Health.
APPLICATION OF SELECTED METHODS OF REMOTE SENSING FOR DETECTING CARBONACEOUS WATER POLLUTION

Ernst M. Davis and W. J. Fosbury Dec. 1972 181 p refs
(Contract NAS9-12040)
(NASA-CR-128824) Avail: NTIS HC \$11.25 CSCL 08H

The use of aerial photography to determine the nature and extent of water pollution from carbonaceous materials is discussed. Flights were conducted over the Galveston Bay estuarine complex. Ground truth data were developed from field sampling of the waters in a region near the Houston Ship Channel. Tests conducted in the field were those for the following physical and chemical factors: (1) pH, (2) dissolved oxygen, (3) temperature, and (4) light penetration. Laboratory analyses to determine various properties of the water are described and the types of instruments used are identified. Results of the analyses are presented as charts and graphs. Author

N73-20354* Environmental Research Inst. of Michigan, Ann Arbor.

TASK 5: RECREATIONAL LAND USE, 1387

I. Setting, Principal Investigator *In its Process*, and Analysis of ERTS-1 Remotely Sensed Data 15 Mar. 1973 3 p

(E73-10392) CSCL 08F

N73-20357* Environmental Research Inst. of Michigan, Ann Arbor.

TASK 8: WATER QUALITY MONITORING, 1400

C. T. Wozniak, Principal Investigator *In its Process*, and Analysis of ERTS-1 Remotely Sensed Data 15 Mar. 1973 1 p

(E73-10395) CSCL 08H

N73-20358* Environmental Research Inst. of Michigan, Ann Arbor.

TASK 9: OIL POLLUTION DETECTION, 1389

Robert Horvath, Principal Investigator *In its Process*, and Analysis of ERTS-1 Remotely Sensed Data 15 Mar. 1973 2 p

(E73-10396) CSCL 08H

N73-20368* Alaska Univ., Fairbanks.
FEASIBILITY STUDY FOR LOCATING ARCHAEOLOGICAL VILLAGE SITES BY SATELLITE REMOTE SENSING TECHNIQUES Bimonthly Progress Report
John P. Cook, Principal Investigator 31 Mar. 1973 8 p
(Contract NAS5-21833)
(E73-10408; NASA-CR-131142; BMPR-4) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. Examination of NASA-provided aerial photography at the Pt. Hope, Alaska area has revealed numerous house pits, or the remains of former subterranean houses which have caved in. Although three major groupings of former house sites have previously been identified, a fourth area, north of the group known as Jabbertown had not previously been identified. It appears that this fourth site is quite extensive and may be of significance to understanding the sequence of habitation of the Pt. Hope location.

N73-20379* Tennessee Univ., Knoxville.
EXTENT OF CYCLIC AND CHANGING ECOLOGICAL PHENOMENA AND SEMIPERMANENT VEGETATION ECOSYSTEM INTERFACES. ECOLOGICAL APPLICATIONS OF ERTS-A IMAGERY First Cook Report, 1 Oct. - 1 Dec. 1972

H. R. DeSelm, Principal Investigator 1 Dec. 1972 14 p refs
Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
(Contract NAS5-21882)
(E73-10417; NASA-CR-131155) Avail: NTIS HC \$3.00 CSCL 08F

N73-20381* Old Dominion Univ. Research Foundation, Norfolk, Va.

REMOTE DETECTION OF AEROSOL POLLUTION BY ERTS
Semiannual Report, 4 Aug. 1972 - 31 Jan. 1973

G. E. Copeland, Principal Investigator, A. R. Bandy, E. C. Kindle, R. N. Blais, and G. M. Hilton 31 Jan. 1973 9 p
(Contract NAS5-21816)

(E73-10419; NASA-CR-131209) Avail: NTIS HC \$3.00 CSCL 048

The author has identified the following significant results. Photogrammetric and densitometric examination of ERTS-1 MSS imagery of eastern Virginia coupled with extensive ground truth air quality and meteorological data has shown that the identification and surveying of fixed particulate emitters (smoke plumes) is feasible. A description of the ground truth network is included. The quantitative monitoring of smoke stacks from orbital altitudes over state-size regions appears possible when tied to realistic plume models and minimal ground truth. Contrast reductions over urban areas can possibly be utilized to produce isopleths of particulates when supplemented by local measurements.

N73-20384* Brevard County Planning Dept., Titusville, Fla.
URBAN AND REGIONAL PLANNING PROPOSAL NO. Y-10-066-001 Progress Report, 1 Feb. - 31 Mar. 1973

John W. Hannah, Garland L. Thomas, and Fernando Esparza, Principal Investigators 31 Mar. 1973 18 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 (Contract NAS5-21847)

(E73-10423; NASA-CR-131213) Avail: NTIS HC \$3.00 CSCL 138

The author has identified the following significant results. An investigation is underway to determine the applicability of ERTS-1 data to urban and regional planning problems, using data for East Central Florida. Small scale land use mapping is feasible. Urban and commercial areas are sufficiently distinguishable that ERTS-1 appears to be a useful tool for monitoring urban and commercial growth. Development patterns of cities, growth patterns of cities, and distribution and changes in certain sectors within cities can be analyzed effectively. Digital analysis methods are proving useful.

N73-20388* Dartmouth Coll., Hanover, N.H. Dept. of Geography.

LAND USE IN NORTHERN MEGALOPOLIS Progress Report
Robert B. Simpson, Principal Investigator 30 Mar. 1973 3 p
(Contract NAS5-21749)

(E73-10427; NASA-CR-13127; PR-5) Avail: NTIS HC \$3.00 CSCLO8F

N73-20391* Bendix Corp., Ann Arbor, Mich.
ECOLOGICAL EFFECTS OF STRIP MINING IN OHIO Bimonthly Progress Report, 1 Jan. - 1 Mar. 1973

Phillip E. Chase, Principal Investigator 1 Mar. 1973 4 p
(Contract NAS5-21762)

(E73-10430; NASA-CR-131220) Avail: NTIS HC \$3.00 CSCL 081

The author has identified the following significant results. ERTS-1 imagery has identified when reclamation has proved successful, when little lateral extension has occurred in the strip mine, when water has filled an impoundment (4 - 5 acres), and detected narrow contour mines. It has been proven that the CCT contains more information than the imagery received from NASA. A stream is visible in the band 7 digital printout that is not visible in the imagery. Also narrow bodies of water between the high wall and spoils bank and small impoundments (2 - 3 acres) are observed in the digital printout and not in the imagery. Disruption maps (water and bare earth within the mined area) can be made by statistically processing the CCT (decision imagery) or mapping the digital printout with a Bendix digitizer. Reclamation maps will be produced in the near future through decision imagery. There seems little doubt that the mapping of present stripping and the monitoring of the strip mine cycle for changes are practical. Disruption mapping is now an operational capability.

N73-20399* Alaska Univ., Palmer.

IDENTIFICATION OF PHENOLOGICAL STAGES AND VEGETATIVE TYPES FOR LAND USE CLASSIFICATION Bimonthly Progress Report

C. Ivan Branton, Principal Investigator 5 Apr. 1973 30 p
(Contract NAS5-21833)

(E73-10439; NASA-CR-131233; BMPR-4) Avail: NTIS HC \$3.50 CSCL 08F

The author has identified the following significant results. Multispectral reflectance signatures have been obtained from computer printouts from scene 1049-20505. Those signatures have been grouped for 13 dominant physical features in the Matanuska Susitna Valley area of Alaska. The derived signatures will be validated and tested by requesting another symbol-coded computer printout for the same area. It is expected that ERTS-1 imagery collected during late autumn and early spring will provide separations of signatures that are confounded in the 1049-20505 scene. Separating bogs and forests should be much improved when either snow covered or when grasses are brown. Photographs have been made of projections on the color additive viewer, each scene being projected with six different filter combinations. The products will be analyzed and those best suited used for producing color transparencies at a scale of 1:250,000 for overlaying on standard quadrangle maps. Color prints will be processed for use in the field. From digital MSS signatures derived to date, identification has been made of which bands are the most powerful for automated classification of dominant physical features. It has been found that separations among density ranges increase with longer wavelengths. Deriving MSS digital signatures has proven valuable to both digital and visual processing of ERTS-1 data.

N73-20408* Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.

UTILIZATION OF ERTS-1 DATA TO MONITOR AND CLASSIFY EUTROPHICATION OF INLAND LAKES Bimonthly Progress Report, 1 Feb. - 1 Apr. 1973

Phillip E. Chase, Principal Investigator 1 Apr. 1973 6 p
(Contract NAS5-21810)

(E73-10445; NASA-CR-131240) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. Bands 6 and 7 have fine structure as obtained by proper selection of digital levels in processing the CCT's. This is contrary to the imagery density received. This means that the small lakes can be classified in IR for different types of water masses. At least four distinct water masses have been determined for test lakes. They are shoreline, shallow water, and two deep waters. One deep water is patchy and presents difficulty in training set selection. The excellent weather and a completely successful field test form a significant happening. It required 12 orbits over the test area before perfect weather occurred.

N73-20408* Wisconsin Univ., Madison. Environmental Monitoring and Data Acquisition Group.

EVALUATION OF THE APPLICATION OF ERTS-1 DATA TO THE REGIONAL LAND USE PLANNING PROCESS Progress Report, period ending 1 Apr. 1973

James L. Clapp, Principal Investigator 1 Apr. 1973 50 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(Contract NAS5-21754)

(E73-10448; NASA-CR-131243) Avail: NTIS HC \$4.50 CSCL 08F

N73-20415* Maine Dept. of Transportation, Augusta.
TO DEVELOP A LAND USE PEAK RUNOFF CLASSIFICATION SYSTEM FOR HIGHWAY ENGINEERING PURPOSES Progress Report

Ernest G. Stoeckeler, Principal Investigator 1 Apr. 1973 3 p
(Contract NAS5-21772)

(E73-10456; NASA-CR-131266; PR-5) Avail: NTIS HC \$3.00 CSCL 13B

02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

N73-20418* Mississippi State Univ., State College. Dept. of Electrical Engineering.
STUDY OF THE APPLICATION OF REMOTE SENSING DATA TO LAND USE PLANNING ON THE MISSISSIPPI GULF COAST Progress Report
 Frank Ingels, Principal Investigator 8 Apr. 1973 4 p
 (Contract NAS5-21817)
 (E73-10460; NASA-CR-131260) Avail: NTIS HC \$3.00 CSCL 08B

N73-20419* Kansas Univ./Center for Research, Inc., Lawrence. Remote Sensing Lab.
LAND USE CLASSIFICATION USING TEXTURE INFORMATION IN ERTS-A MSS IMAGERY
 Robert M. Haralick, Principal Investigator; K. Shanmugam, and Robert Bosley Jan. 1973 30 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
 (Contract NAS5-21822)
 (E73-10461; NASA-CR-131261; TR-2262-1) Avail: NTIS HC \$3.50 CSCL 08B

The author has identified the following significant results. Preliminary digital analysis of ERTS-1 MSS imagery reveals that the textural features of the imagery are very useful for land use classification. A procedure for extracting the textural features of ERTS-1 imagery is presented and the results of a land use classification scheme based on the textural features are also presented. The land use classification algorithm using textural features was tested on a 5100 square mile area covered by part of an ERTS-1 MSS band 5 image over the California coastline. The image covering this area was blocked into 648 subimages of size 8.9 square miles each. Based on a color composite of the image set, a total of 7 land use categories were identified. These land use categories are: coastal forest, woodlands, annual grasslands, urban areas, large irrigated fields, small irrigated fields, and water. The automatic classifier was trained to identify the land use categories using only the textural characteristics of the subimages; 75 percent of the subimages were assigned correct identifications. Since texture and spectral features provide completely different kinds of information, a significant increase in identification accuracy will take place when both features are used together.

N73-20436* Arizona Univ., Tucson. Office of Arid Lands Studies.
NATURAL RESOURCE INVENTORY FOR URBAN PLANNING UTILIZING REMOTE SENSING TECHNIQUES
 Kenneth E. Foster, Paul F. Mackey (City of Tucson), and Charles D. Bonham (Colo. State Univ.) Oct. 1972 18 p refs
 (Grant NGL-03-002-313)
 (NASA-CR-131279; OALS-Bull-3) Avail: NTIS HC \$3.00 CSCL 14E

Remote sensing techniques were applied to the lower Pantano Wash area to acquire data for planning an ecological balance between the expanding Tucson metropolitan area and its environment. The types and distribution of vegetation are discussed along with the hydrologic aspects of the Wash. F.O.S.

N73-20468* National Bureau of Standards, Washington, D.C. Heat Div.
OPTICAL RADIATION MEASUREMENTS: THE IMPACT OF RADIOMETRY AND PHOTOMETRY AND THE ROLE OF NBS
 Bruce Steiner Mar. 1973 58 p refs
 (NBS-TN-594-4) Avail: SOD \$0.80 domestic postpaid or \$0.55 GPO Bookstore

The impact of radiometry and photometry on a number of problems of national concern and the role of NBS in the measurement aspect of those problems is studied. National problems covered include public health, public safety, the energy crisis, meteorology, pollution, and agriculture; crime prevention, air surveillance, and space surveillance. Author

N73-21163* Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Physik der Atmosphaere.

RESEARCH AT THE DFVLR IN THE FIELD OF ENVIRONMENTAL PROTECTION. PART 2: NOISE ABATEMENT, WATER AND LANDSCAPE, TECHNOLOGY [FORSCHUNGS-ARBEITEN IN DER DFVLR AUF DEM GEBIET DES UMWELTSCHUTZES. TEIL 2: LAERMBEKAEMPFGUNG, GEWAESSERSCHUTZ, NATUR UND LANDSCHAFT, UMWELTFREUNDLICHE TECHNIK]
 Dieter Paffrath Dec. 1972 84 p refs In GERMAN; ENGLISH summary
 (DLR-Mitt-72-15) Avail: NTIS HC \$6.25; DFVLR, Porz, West Ger: 21.90 DM

Research work is reported in the fields of abatement of noise from aircraft engines and exhaust jets; formation and propagation of the supersonic boom; measurement of noise emission from aircraft; and noise reduction by constructive means, airport location planning, and layout of flight patterns. Remote sensing instrumentation and techniques were developed for the detection and monitoring of water pollution, and for surveying the change of state at the earth's surface. ESRO

N73-21308* Kansas Univ./Center for Research, Inc., Lawrence. **VARIATIONS IN THE DETECTABILITY OF MAJOR AIRPORTS IN NORTHEASTERN KANSAS AND NORTHWESTERN MISSOURI**

Stanley A. Morain, Principal Investigator, Jerry C. Coiner, and Donald L. Williams 6 Jan. 1973 2 p ERTS
 (Contract NAS5-21822)
 (E73-10471; NASA-CR-131281) Avail: NTIS HC \$3.00 CSCL 01E

The author has identified the following significant results. Six major airports are located within the ERTS-1 imagery. Runways at four of the airports are readily detectable. Runways at the other two airports are not detectable and the locations must be inferred by other means. This variation is attributed to variation in runway surface composition.

N73-21310* Nevada Univ., Reno. Mackay School of Mines. **COMPILE TWO PHOTOMAPS OF THE STATE OF NEVADA** Progress Report
 Joseph Lintz, Jr., Principal Investigator 29 Jan. 1973 3 p ERTS
 (Contract NAS5-21864)
 (E73-10473; NASA-CR-131298) Avail: NTIS HC \$3.00 CSCL 08B

N73-21321* Corps of Engineers, Champaign, Ill. **EFFECTS OF CONSTRUCTION AND STAGED FILLING OF RESERVOIRS ON THE ENVIRONMENT AND ECOLOGY** Progress Report, 8 Feb. - 8 Apr. 1973
 Ravinder K. Jain, Principal Investigator 8 Apr. 1973 2 p ERTS
 (NASA Order S-70255-AG)
 (E73-10484; NASA-CR-131304) Avail: NTIS HC \$3.00 CSCL 08H

N73-21326* Geological Survey, Washington, D.C. **CENSUS CITIES EXPERIMENT IN URBAN CHANGE DETECTION** Progress Report, 31 Jan. - 28 Feb. 1973
 James R. Wray, Principal Investigator 1 Mar. 1973 6 p ERTS
 (NASA Order S-70243-AG-2)
 (E73-10490; NASA-CR-131310) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. Computer compatible tapes for an early ERTS-1 multispectral scanner image over the San Francisco Bay area are being used to classify and analyze land use in this metropolitan region. NASA aircraft underflight data and land use maps from the Census Cities ERTS-1 experiment are providing training samples. The tape record has been reformatted for use with the LARSYSSA pattern recognition and classification algorithms developed at the Purdue University Laboratory for Applications of Remote Sensing. Trial land use classification systems are being compared with color infrared photography and ground truth data for San Jose and vicinity.

N73-21333* Geological Survey, Washington, D.C.
**CENTRAL ATLANTIC REGIONAL ECOLOGICAL TEST SITE:
 A PROTOTYPE REGIONAL ENVIRONMENTAL INFORMATION
 SYSTEM** Progress Report, 1 Jan. - 28 Feb. 1973
 Robert H. Alexander, Principal Investigator 1 Mar. 1973 16 p
 ERTS
 (NASA Order S-70243-AG-3)
 (E73-10497; NASA-CR-131317) Avail: NTIS HC \$3.00 CSCL
 06F

The author has identified the following significant results. A comparison of photomorphologic regions from an uncontrolled ERTS-1 mosaic of CARETS to land use areas on a map published in the National Atlas revealed close correlations in non-urban regions. Such regional scale analysis of ERTS-1 data has the potential for providing an economical sampling strategy for selecting sites for more detailed field measurements if other environmental variables can be correlated with patterns on ERTS-1 imagery. ERTS-1 imagery has also revealed for the first time the appearance of CARETS during the winter months. Investigators have identified extensive areas of conifers, which have previously been indistinguishable from deciduous vegetation. Imagery has also shown very clearly the extent of snow cover at a particular time over the region. The evaluation of ERTS-1 imagery used for the land use mapping of the shore zone of CARETS, has shown that the presence or absence of elements of an hierarchical system of shoreline landforms can help identify areas of potential rapid change. Changes in land use class distributions on the Barrier Islands signify the environmental response to natural and man-caused processes. Both environmental vulnerability and sensitivity can be estimated from the repetitive ERTS-1 coverage of long reaches of the CARETS coast. Results indicate potential applications to land use planning, management, and regional environmental quality analysis.

N73-21700* Michigan Univ., Ann Arbor. High Altitude Engineering Lab.
SATELLITE MEASUREMENT OF STRATOSPHERIC POLLUTANTS AND MINOR CONSTITUENTS BY SOLAR OCCULTATION: A PRELIMINARY REPORT Final Report
 S. R. Drayson, F. L. Bartman, W. R. Kuhn, and R. Tallamraju
 Nov. 1972 149 p refs
 (Grant NOAA-NG-10-72; ORA Proj. 011023)
 (Rept-011023-1-T) Avail: NTIS HC \$9.50

The feasibility of determining concentrations of pollutants and minor constituents from satellite measurement of solar occultation absorption in the infrared is examined. The molecules considered include water vapor, O₃, OH, CO₂, CO, CH₄, N₂O, NO, NO₂, N₂O₅, HNO₃, and also aerosols. A survey of experimentally and theoretically determined concentrations and of infrared spectral properties is made for each constituent. Atmospheric applications and estimates of stratospheric absorption are included. Author.

N73-22275* Army Cold Regions Research and Engineering Lab., Hanover, N.H.
ARCTIC AND SUBARCTIC ENVIRONMENTAL ANALYSES UTILIZING ERTS-1 IMAGERY Progress Report, 23 Jun. 23 Dec. 1972
 Duwayne M. Anderson, Harlan L. McKim, Richard K. Haugen, Lawrence W. Gatto, Charles W. Slaughter, and Thomas L. Marlar, Principal Investigators 23 Dec. 1972 50 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
 (NASA Order S-70243-AG)
 (E73-10421; NASA-CR-131211) Avail: NTIS HC \$4.50 CSCL 08L

N73-22277* General Electric Co., Philadelphia, Pa.
APPLICATION OF EARTH RESOURCES TECHNOLOGY SATELLITE DATA TO URBAN DEVELOPMENT AND REGIONAL PLANNING: TEST SITE, COUNTY OF LOS ANGELES Bimonthly Progress Report, Jan. - Feb. 1973

Surendra Raje, Principal Investigator, Richard Economy, Jene McKnight (Los Angeles County Regional Planning Comm.), and Phil Garofalo (Los Angeles County Regional Planning Comm.) 10 Mar. 1973 38 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
 (Contract NAS5-21797)
 (E73-10486; NASA-CR-131306; BMPR-2) Avail: NTIS HC \$4.00 CSCL 08B

The author has identified the following significant results. Significant results have been obtained from the analyses of ERTS-1 imagery from five cycles over Test Site SR 124 by classical photointerpretation and by an interactive hybrid multispectral information extraction system (GEMS). Photointerpretation has produced over 25 overlays at 1:1,000,000 scale depicting regional relations and urban structure in terms of several hundred linear and areal features. A possible new fault lineament has been discovered on the northern slope of the Santa Monica mountains. GEMS analysis of the ERTS-1 products has provided new or improved information in the following planning data categories: urban vegetation; land cover segregation; manmade and natural impact monitoring; urban design; land suitability. ERTS-1 data analysis has allowed planners to establish trends that directly impact planning policies. For example, detectable grading and new construction sites quantitatively indicated the extent, direction, and rate of urban expansion which enable planners to forecast demand and growth patterns on a regional scale. This new source of information will not only assist current methods to be more efficient, but permits entirely new planning methodologies to be employed.

N73-22280* Mitre Corp., McLean, Va.
INVESTIGATION OF ENVIRONMENTAL INDICES FROM THE EARTH RESOURCES TECHNOLOGY SATELLITES Bimonthly Progress Report
 Edward A. Ward, Principal Investigator and R. P. Ouellette 30 Apr. 1973 4 p ERTS
 (Contract NAS5-21482)
 (E73-10505; NASA-CR-131543; D22-1573) Avail: NTIS HC \$3.00 CSCL 08D

The author has identified the following significant results. Correlation between the EPA/NOAA Atmospheric Turbidity Network data and the average greyiness of ERTS-1 imagery over the same test site gives promise of a use for ERTS as a source of mesoscale turbidity information. Care however must be given to avoid weather front and urban effect anomalies.

N73-22281* Dartmouth Coll., Hanover, N.H. Dept. of Geography.
LAND USE IN NORTHERN MEGALOPOLIS Progress Report
 Robert B. Simpson, Principal Investigator 4 May 1973 2 p ERTS
 (Contract NAS5-21749)
 (E73-10506; NASA-CR-131544; PR-6) Avail: NTIS HC \$3.00 CSCL 08F

N73-22286* Army Cold Regions Research and Engineering Lab., Hanover, N.H.
ARCTIC AND SUBARCTIC ENVIRONMENTAL ANALYSES UTILIZING ERTS-1 IMAGERY Bimonthly Progress Report
 Duwayne M. Anderson, H. L. McKim, R. K. Haugen, L. W. Gatto, C. W. Slaughter, and T. L. Marlar, Principal Investigators 23 Apr. 1973 51 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
 (NASA Order S-70253-AG)
 (E73-10511; NASA-CR-131621; BMPR-4) Avail: NTIS HC \$4.75 CSCL 08L

N73-22290* Maine Dept. of Transportation, Augusta.
DETECTION AND MONITORING VEGETATION DAMAGE ASSOCIATED WITH HIGHWAY FACILITIES Progress Report
 E. G. Stoeckler, Principal Investigator 1 May 1973 2 p ERTS
 (Contract NAS5-21724)
 (E73-10522; NASA-CR-131489; PR-6) Avail: NTIS HC \$3.00 CSCL 02B

02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

N73-22300*# Geological Survey, McLean, Va. Topographic Div.

MAN MADE CULTURE INTERPRETATION AND CULTURE REVISION OF SMALL SCALE MAPS Progress Report, 1 Jan. - 31 Mar. 1973

William J. Kosco, Principal Investigator 31 Mar. 1973 3 p ERTS

(NASA Order S-70243-AG)

(E73-10536; NASA-CR-131612) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. A major interstate highway added to the Wilmington, Del., quadrangle by another revision method was determined by the ERTS-1 data to have been misplotted from its true position. In addition to the experiment, where ERTS-1 data is available and small-scale revision is in progress, the ERTS-1 data is routinely being used to make additions and deletions of hydrographic features.

N73-22301*# Bureau of Reclamation, Denver, Colo.

APPLICATION OF REMOTE SENSING TO SELECTED BUREAU OF RECLAMATION PROJECTS Progress Report, 1 Mar. - 30 Apr. 1973

Larry D. Cast, Principal Investigator 1 May 1973 2 p ERTS (NASA Order S-70243-AG)

(E73-10537; NASA-CR-131613) Avail: NTIS HC \$3.00 CSCL 08B

N73-22302*# Geological Survey, Washington, D.C.

CENSUS CITIES EXPERIMENT IN URBAN CHANGE DETECTION Progress Report, 1 Mar. - 30 Apr. 1973

James R. Wray, Principal Investigator 1 May 1973 6 p ERTS (NASA Order S-70243-AG-2)

(E73-10538; NASA-CR-131614) Avail: NTIS HC \$3.00 CSCL 08B

N73-22303*# Geological Survey, Washington, D.C.

THE UTILIZATION OF ERTS-1 GENERATED PHOTOGRAPHS IN THE EVALUATION OF THE IRANIAN PLAYAS AS POTENTIAL LOCATIONS FOR ECONOMIC AND ENGINEERING DEVELOPMENT Progress Report, 1 Mar. - 30 Apr. 1973

Daniel B. Krinsley, Principal Investigator 1 May 1973 3 p refs ERTS

(NASA Order S-70243-AG-3)

(E73-10539; NASA-CR-131615) Avail: NTIS HC \$3.00 CSCL 08H

N73-22334*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

URBAN LAND USE MAPPING BY MACHINE PROCESSING OF ERTS-1 MULTISPECTRAL DATA: A SAN FRANCISCO BAY AREA EXAMPLE

R. Ellefsen (Calif. State Univ., San Jose), P. H. Swain, and J. R. Wray (Geol. Surv.) 1973 16 p ref Presented at Conf. on Machine Processing of Remotely Sensed Data, Lafayette, Ind., 1973

(Grant NGL-15-005-112)

(NASA-CR-131589; LARS-Inform-Note-032973) Avail: NTIS HC \$3.00 CSCL 08B

A study is reported to develop computer produced urban land use maps using multispectral scanner data from a satellite. Data processing is discussed along with the results of the San Francisco Bay area, which was chosen as the test area. F.O.S.

N73-22347*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

PREPARATION OF URBAN LAND USE INVENTORIES BY MACHINE-PROCESSING OF ERTS MSS DATA

William Todd, Paul Mausel, and Kenneth Wenner 1973 9 p ref

(Grant NGL-15-005-112)

(NASA-CR-131576; LARS-022873) Avail: NTIS HC \$3.00 CSCL 08F

Spectral classes of urban phenomena identified from ERTS multispectral scanner data in Milwaukee included Suburban, Inner City, Industry, Grassy (open area), Road, Wooded Suburb, Water, Cloud, and Shadow. The Milwaukee spectral class statistics were used to classify the Chicago area, within the same ERTS frame, and similar results were achieved. In another ERTS frame, Marion County (Indianapolis) data were classified into similar classes. The Marion County ERTS study was supported by a land use classification of an area near downtown Indianapolis that utilized 12-band MSS data collected by aircraft from 3000 feet. The results of the ERTS analyses suggest that satellite data will be a useful tool for the urban planner for monitoring urban land use.

Author

N73-22584*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

MEASUREMENT OF HIGH ALTITUDE AIR QUALITY USING AIRCRAFT

Richard A. Rudey and Porter J. Perkins 13 Jun. 1973 15 p refs Proposed for presentation at Intern. Conf. on the Environ. Impact of Aerospace Operations in the High Atmosphere, Denver, 11-13 Jun. 1973; sponsored by Am. Inst. of Aeron. and Astronaut. and the Am. Nucl. Soc.

(NASA-TM-X-68221; E-7422) Avail: NTIS HC \$3.00 CSCL 04B

The minor atmospheric constituents associated with and affected by aircraft exhaust emissions at altitudes from 6 to 20 km will be monitored in flight programs presently being implemented. Preliminary in situ data are available from flight tests of dedicated instruments to be used in these programs. A Global Atmospheric Sampling Program using Boeing 747 airliners was determined to be feasible in studies conducted by airlines and airframe companies. Worldwide monitoring in the troposphere and the lower stratosphere is planned. Stratospheric air sampling on a more local basis will be done with a U2 aircraft. Measuring system evaluations and improvements have been required to detect the low background levels.

Author

N73-23415*# Earth Satellite Corp., Washington, D.C.

APPLICATION OF ERTS-1-DATA TO THE PROTECTION AND MANAGEMENT OF NEW JERSEY'S COASTAL ENVIRONMENT Progress Report, period ending 30 Apr. 1973

Roland S. Yunghans, Edward B. Feinberg, Robert L. Mairs, Principal Investigators, Dennid Woodward, David A. Thibault, and Robert T. Macomber 8 May 1973 9 p Prepared for N. J. Dept. of Environ. Protect. ERTS

(Contract NAS5-21765)

(E73-10527; NASA-CR-131566) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. New Jersey's planned, regionalized network of sewage disposal facilities has been plotted on an ERTS-1 mosaic and circulation parameters for each of the planned outfall locations have been analyzed using the ERTS-1 imagery and comparative aircraft photography. Work is continuing on the circulation and dispersion of barge-dumped wastes in the New York Bight area. One of the largest remote sensing experiments ever attempted in this country was completed on April 7, 1973 during the ERTS-1 overpass. The test area included the northern portion of New Jersey and the Raritan Bay - New York Harbor area. Three NASA aircraft, two helicopters, nine surface vessels, 40 ground team personnel, and numerous oceanographic, radiometric, and meteorological equipment were deployed in an effort to characterize the surface and near-surface circulation dynamics in this 600 square mile area, during an entire tidal cycle. The analyses of these data in concert with all previous ERTS-1 overpasses will provide information that can lead to a better and more rational use of the nearshore marine environment. The data will be utilized to plan future outfall locations, regulating offshore disposal of wastes, etc.

02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

N73-23429*# Geological Survey, Washington, D.C.
**CENTRAL ATLANTIC REGIONAL ECOLOGICAL TEST SITE:
 A PROTOTYPE REGIONAL ENVIRONMENTAL INFORMATION
 SYSTEM** Progress Report, 1 Mar. - 30 Apr. 1973
 Robert H. Alexander, Principal Investigator and Herbert K. McGinty
 1 May 1973 12 p ERTS
 (NASA Order S-70243-AG-3)
 (E73-10557; NASA-CR-131856) Avail: NTIS HC \$3.00 CSCL
 08F

N73-23439*# Purdue Univ., Lafayette, Ind.
**IDENTIFICATION AND MAPPING OF LAND USE CLASSES
 IN THE KANSAS CITY AREA BY MACHINE PROCESSING
 OF ERTS-1 DATA**
 Marion F. Baumgardner, Principal Investigator 18 May 1973
 1 p ERTS
 (Contract NAS5-21785)
 (E73-10578; NASA-CR-131882) Avail: NTIS HC \$3.00 CSCL
 08B

N73-23440*# Oregon State Univ., Corvallis, School of
 Agriculture.
**COMPARATIVE EVALUATION OF ERTS IMAGERY FOR
 RESOURCE INVENTORY IN LAND USE PLANNING** Progress
 Report, period ending 30 Apr. 1973
 Gerald H. Simonson, Principal Investigator 10 May 1973 10 p
 ERTS
 (Contract NAS5-21831)
 (E73-10579; NASA-CR-131883) Avail: NTIS HC \$3.00 CSCL
 05B

The author has identified the following significant results.
 Numerous previously unmapped faults in central Oregon have
 been distinguished on ERTS-1 imagery. Tectonic mapping of
 fault-controlled linears demonstrates the utility of ERTS-1 imagery
 as a mean of illustrating and studying the regional tectonics of
 the state. Soil colors observed on ERTS-1 frame 1075-18150-5
 at the eastern end of the Columbia basin correlate very well
 with those from descriptions of soils from that area. Digital output
 from frame 1021-18151 has shown the enhanced ability to
 interpret such features as joint patterns, shadowed landslide
 blocks, bottomlands, and drainage patterns. Widespread use of
 wheat-fallow rotation in northern Umatilla County, Oregon, insures
 that nearly one-half of the cultivated soil is devoid of vegetation
 much of the time. On ERTS-1 imagery, fallow fields are only
 slightly darker than fields of wheat stubble at the western end
 of the transect. Similar climate-related contrasts in soil color
 are visible on ERTS-1 imagery from several other portions of
 the Columbia Basin. Absence of steep topography in the area
 mentioned, however, minimizes the disturbing effect caused by
 shadows.

N73-23442*# Minnesota State Planning Agency, St. Paul.
LAND USE MANAGEMENT IN MINNESOTA Progress
 Report, 1 Mar. - 30 Apr. 1973
 Joseph E. Sizer, Principal Investigator 30 Apr. 1973 6 p ERTS
 (Contract NAS5-21801)
 (E73-10581; NASA-CR-131885) Avail: NTIS HC \$3.00 CSCL
 08B

N73-24345*# Environmental Research Inst. of Michigan, Ann
 Arbor.
**[ERTS-1 INVESTIGATIONS CONDUCTED BY ENVIRON-
 MENTAL RESEARCH INSTITUTE OF MICHIGAN]** Bimonthly
 Report, 1 Mar. - 30 Apr. 1973
 Frederick J. Thomson, Principal Investigator 9 May 1973 18 p
 Original contain imagery. Original photography may be purchased
 from EROS Data Center, 10th and Dakota Avenue, Sioux Falls,
 S. D. 57198 ERTS
 (Contract NAS5-21783)
 (E73-10565; NASA-CR-131651; BMR-5; Rept-193300-13-L)
 Avail: NTIS HC \$3.00 CSCL 05B

Progress is reported for the following tasks: (1) calculation
 of water depth from ERTS-1 data; (2) terrain classification maps
 of Yellowstone Park; (3) atmospheric effects on ERTS-1 data;
 (4) lake ice surveillance using radar imagery; (5) digital land

use mapping in Oakland County, Michigan; (6) IFYGL hydrological
 data for Lake Ontario Basin; (7) image enhancement and advanced
 information extraction techniques; (8) monitoring water quality
 and ocean dumping; (9) oil pollution detection; and (10) ratio
 mapping of iron ore deposits in Atlantic City District, Wyoming.

N73-24350*# Environmental Research Inst. of Michigan, Ann
 Arbor.
RECREATIONAL LAND USE, TASK 6
 I. Sattinger, Principal Investigator *In its* ERTS-1 Invest. conducted
 by Environ. Res. Inst. of Mich. 9 May 1973 1 p ERTS
 (E73-10570) CSCL 08B

N73-24353*# Environmental Research Inst. of Michigan, Ann
 Arbor.
WATER QUALITY MONITORING, TASK 8
 C. T. Wezernak, Principal Investigator *In its* ERTS-1 Invest.
 conducted by Environ. Res. Inst. of Mich. 9 May 1973 1 p
 ERTS
 (E73-10573) CSCL 08J

N73-24354*# Environmental Research Inst. of Michigan, Ann
 Arbor.
OIL POLLUTION DETECTION, TASK 9
 R. Horvath, Principal Investigator *In its* ERTS-1 Invest. conducted
 by Environ. Res. Inst. of Mich. 9 May 1973 3 p ERTS
 (E73-10574) CSCL 08J

N73-24366*# Brevard County Planning Dept., Titusville, Fla.
PLANNING APPLICATIONS IN EAST CENTRAL FLORIDA
 Progress Report, 1 Apr. - 31 May 1973
 John W. Hannah, Garland L. Thomas, and Fernando Esparza,
 Principal Investigators 31 May 1973 20 p ERTS
 (Contract NAS5-21847)
 (E73-10605; NASA-CR-132002) Avail: NTIS HC \$3.00 CSCL
 08B

N73-24370*# Headquarters US Army IAGS for EROS
 Guatemala, APO New York.
**INVESTIGATION OF THE UTILITY OF ERTS-1 IMAGERY
 FOR UPDATING LAND USE AND RESOURCE DATA IN
 GUATEMALA** Progress Report, Jul. 1972 - Mar. 1973
 Luis E. Garcia, Principal Investigator 10 Apr. 1973 52 p
 Sponsored by NASA ERTS
 (E73-10609; NASA-CR-132006) Avail: NTIS HC \$4.75 CSCL
 08B

The author has identified the following significant results.
 An intensive analysis of the imagery received has been completed
 and findings are reported. Conclusions are restricted by receipt
 of only limited amounts of cloud-free coverage of test areas. In
 most cases the interpretation findings were as anticipated from
 previous experience with multiband images. Band 7 provides
 promising indication of some economically important environmen-
 tal communities. It also permits viewing through thin cirrus cloud
 layers for features of medium to high contrast. Band 4 provides
 information of submerged reefs and of movement of suspended
 sediment bodies in water areas. ERTS-1 bulk images have
 positional mapping accuracy adequate for representation at
 1:1,000,000 scale maps. Cloud cover is a true constraint to
 useable satellite coverage.

N73-24372*# Maine Dept. of Transportation, Augusta.
**DETECTION AND MONITORING VEGETATION DAMAGE
 ASSOCIATED WITH HIGHWAYS AND HIGHWAY FACILI-
 TIES** Interim Report, Nov. 1972 - May 1973
 Ernest G. Stoeckeler, Principal Investigator May 1973 6 p
 ERTS
 (Contract NAS5-21724)
 (E73-10611; NASA-CR-132008) Avail: NTIS HC \$3.00 CSCL
 08F

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N73-24379*# Alaska Univ., Palmer.

IDENTIFICATION OF PHENOLOGICAL STAGES AND VEGETATIVE TYPES FOR LAND USE CLASSIFICATION Bimonthly Progress Report

Ivan Branton, Principal Investigator 1 Jun. 1973 6 p ERTS (Contract NAS5-21833)
(E73-10618; NASA-CR-132029; BMPR-5) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. A large grassland was located on the Kenai Peninsula which may be a potential grazing land. Two 1:250,000 vegetation maps were constructed from ERTS-1 scenes 1049-20505 and 1066-20453 using 70 mm MSS chips and black and white prints for an area of 3.5 million acres. Another area (464,000 acres) was mapped using digital data. The latter map is the most accurate and detailed vegetation map of that area produced to date. Areal extents of identified vegetation types were derived for the area mapped from digital data. Early spring (prior to leafing out of the deciduous trees) is suspected as being the best time for mapping Alaskan vegetation from MSS data due to the radiometrically distinctness of the vegetation communities at that time.

N73-24386*# Grumman Ecosystems Corp., Bethpage, N.Y.

VIRGIN ISLANDS ERTS-1 EXPERIMENT NO. 589 Progress Report, Apr. - May 1973

W. C. Coulbourn, Principal Investigator 5 Jun. 1973 2 p ERTS (Contract NAS5-21811)
(E73-10626; NASA-CR-132037) Avail: NTIS HC \$3.00 CSCL 08F

N73-24390*# Dartmouth Coll., Hanover, N.H. Dept. of Geography.

LAND USE OF NORTHERN MEGALOPOLIS FROM ERTS-1 IMAGERY Interim Report, Dec. 1972 - May 1973

Robert B. Simpson, Principal Investigator 5 Jun. 1973 5 p ERTS (Contract NAS5-21749)
(E73-10630; NASA-CR-132041; S13-116) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. A color-coded urban-type land use map of the three northern megalopolitan states of Massachusetts, Connecticut, and Rhode Island has been completed from ERTS-1 images. A computer data bank containing 11 categories of land use for the entire area by 1/4-square-kilometer cells is 80% completed. When completed, the data bank will permit the investigation to proceed to brief analytical studies for completion of the study.

N73-24397*# Alaska Univ., Fairbanks.

FLEASIBILITY STUDY FOR LOCATING VILLAGE SITES BY SATELLITE REMOTE SENSING TECHNIQUES Bimonthly Progress Report

John P. Cook, Principal Investigator 31 May 1973 13 p ERTS (Contract NAS5-21833)
(E73-10638; NASA-CR-132097; BMPR-5) Avail: NTIS HC \$3.00 CSCL 08B

N73-25141*# Texas A&M Univ., College Station. Remote Sensing Center.

WATER QUALITY PARAMETER MEASUREMENT USING SPECTRAL SIGNATURES

P. E. White May 1973 171 p refs (Grant NGL-44-001-001)
(NASA-CR-132997; RSC-42) Avail: NTIS HC \$5.75 CSCL 07D

Regression analysis is applied to the problem of measuring water quality parameters from remote sensing spectral signature data. The equations necessary to perform regression analysis are presented and methods of testing the strength and reliability of a regression are described. An efficient algorithm for selecting an optimal subset of the independent variables available for a regression is also presented. Author

N73-25338*# Bendix Corp., Ann Arbor, Mich.

DETERMINE UTILITY OF ERTS-1 TO DETECT AND MONITOR AREA STRIP MINING AND RECLAMATION Interim Report, Nov. 1972 - Apr. 1973

Phillip E. Chase, Principal Investigator and Larry Reed May 1973 48 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (Contract NAS5-21762)

(E73-10641; NASA-CR-132100) Avail: NTIS \$4.50 CSCL 08I

N73-25339*# Spectral Africa (Pty) Ltd., Randfontein (Republic of South Africa).

GROWTH AND DECLINE OF VEGETATION ON MINE DUMPS Progress Report, Feb. - Apr. 1973

B. P. Gilbertson, Principal Investigator May 1973 20 p ref Sponsored by NASA ERTS
(E73-10642; NASA-CR-132101; PR-2; Rept-73/11) Avail: NTIS HC \$3.00 CSCL 08F

N73-25346*# Geological Survey, Washington, D.C.

LAND USE MAPPING AND MODELLING FOR THE PHOENIX QUADRANGLE Progress Report, 1 Mar. - 30 Apr. 1973

John L. Place, Principal Investigator 1 May 1973 7 p ERTS (NASA Order S-70243-AG)
(E73-10650; NASA-CR-132241) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. Comparison of 9 x 9 MSS band images and color composites made from bands 4, 5, and 6 showing vegetated areas near Phoenix during the summer, fall, and winter seasons aided in definitely establishing that certain land areas were being used as agricultural land and not as rangeland. Agricultural land, which appeared to be fallow, idle, or not irrigated, often became more readily identifiable as agricultural land when comparing different images of identical land areas which have been affected by seasonal vegetation changes. Experimentation with the Bausch and Lomb Zoom Transferscope using MSS images of identical areas in the same spectral band from different time periods, with a quick flip method of alternately viewing the frame areas, enabled rapid detection of a major land use change from agricultural to urban use on the northwest fringe of the metropolitan Phoenix area. The best results in this case were obtained when comparing MSS band 5 images. Examination of MSS transparencies and color composites allowed further updating of a map of land use change in the Phoenix Quadrangle.

N73-25349*# Mississippi State Univ., State College. Dept. of Electrical Engineering.

STUDY OF THE APPLICATION OF REMOTE SENSING DATA TO LAND USE PLANNING ON THE MISSISSIPPI GULF COAST Progress Report

Frank Ingles, Principal Investigator 8 Jun. 1973 6 p ERTS (Contract NAS5-21817)
(E73-10653; NASA-CR-132244; PR-4) Avail: NTIS HC \$3.00 CSCL 08B

N73-25351*# Army Construction Engineering Research Lab., Champaign, Ill.

EFFECTS OF CONSTRUCTION AND STAGED FILLING OF RESERVOIRS ON THE ENVIRONMENT AND ECOLOGY Progress Report, 9 Dec. 1972 - 8 Jun. 1973

R. K. Jain, Principal Investigator 8 Jun. 1973 5 p Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (NASA Order S-70255-AG)

(E73-10655; NASA-CR-132246) Avail: NTIS HC \$3.00 CSCL 08H

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N73-25384*# Earth Satellite Corp., Berkeley, Calif.
A SCHEME FOR THE UNIFORM MAPPING AND MONITORING OF EARTH RESOURCES AND ENVIRONMENTAL COMPLEXES USING ERTS-1 IMAGERY Progress Report
 1 Mar. - 30 Apr. 1973
 Charles E. Poulton, Principal Investigator and Robin I. Welch
 25 May 1973 7 p ERTS
 (Contract NAS5-21830)
 (E73-10689; NASA-CR-132180; PR-4) Avail: NTIS HC \$3.00 CSCL 08B

N73-25375*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
IDENTIFICATION AND MAPPING OF LAND USE CLASSES IN MARION COUNTY (INDIANAPOLIS), INDIANA BY MACHINE PROCESSING OF ERTS-1 MSS DATA
 D. A. Landgrebe, Principal Investigator 18 May 1973 1 p ERTS
 (Contract NAS5-21773)
 (E73-10680; NASA-CR-132187) Avail: NTIS HC \$3.00 CSCL 08B

N73-25383*# Vermont Univ., Burlington.
ENVIRONMENTAL STUDY OF ERTS-A IMAGERY, LAKE CHAMPLAIN BASIN AND VERMONT Bimonthly Report, period ending 1 May 1973
 A. O. Lind, Principal Investigator 1973 5 p ERTS
 (Contract NAS5-21753)
 (E73-10690; NASA-CR-132201) Avail: NTIS HC \$3.00 CSCL 08H

N73-25400*# Mitre Corp., McLean, Va.
INVESTIGATION OF ENVIRONMENTAL INDICES FROM THE EARTH RESOURCES TECHNOLOGY SATELLITES Bimonthly Progress Report
 Edward A. Ward, Principal Investigator 5 Jul. 1973 26 p ERTS
 (Contract NAS5-21482)
 (E73-10709; NASA-CR-133031) Avail: NTIS HC \$3.50 CSCL 06F

N73-25426*# Denver Research Inst., Colo. Industrial Economics Div.
THE NASA ROLE IN MAJOR AREAS OF HUMAN CONCERN: ENVIRONMENTAL QUALITY
 Feb. 1973 17 p refs
 (Contract NASw-2382)
 (NASA-CR-133049) Avail: NTIS HC \$3.00 CSCL 08F

After introducing some of the general factors that have affected progress in the area of environmental quality, NASA program elements are examined to illustrate relevant points of contact. Interpretive steps are taken throughout the report to show a few of the more important ways people's lives have been affected as a result of the work of NASA and other organizations functioning in this area. The principal documents used and interviews conducted are identified. Author

N73-25436# National Field Investigations Center, Denver, Colo.
REMOTE SENSING STUDY OF THERMAL DISCHARGES TO LAKE MICHIGAN, WISCONSIN, ILLINOIS, INDIANA, AND MICHIGAN
 Sep. 1972 77 p Presented at the 14th Session of the Lake Michigan Enforcement Conf., 21 Sep. 1972
 (PB-214503/5) Avail: NTIS HC \$3.00 CSCL 13B

An aerial reconnaissance study was conducted along pre-designated segments of the shoreline of Lake Michigan to document the extent of thermal discharges from the major electric power plants over the area extending from Muskegon, Michigan, to Twin Creeks, Wisconsin. Nine of the ten plants covered were violating the recommended 3 F maximum temperature increase at the distance of 1,000 feet from an outfall. In addition, six of

the power plants were also violating this permitted 3 F increase. It was concluded that the recommendations of the Lake Michigan Enforcement Conference are not being met by many sources of thermal and industrial discharges. GRA

N73-25437# National Field Investigations Center, Denver, Colo.
REMOTE SENSING STUDY OF THERMAL DISCHARGES TO LAKE MICHIGAN: ILLINOIS-INDIANA-MICHIGAN
 Oct. 1972 49 p
 (PB-214407/9) Avail: NTIS HC \$3.00 CSCL 13B

An aerial reconnaissance study was conducted along the shoreline of Lake Michigan from South Haven, Michigan in a clockwise manner through Waukegan, Illinois. The flights were carried out during the afternoon hours on 17 October 1972 and 19 October 1972. The purpose was to document thermal discharges from electric power plants and to see if they were complying with the Lake Michigan Enforcement Conference. It was concluded that the recommendations were not being fulfilled by many sources of thermal and industrial discharges. GRA

N73-25478*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
DEVELOPMENT OF A BREADBOARD MODEL CORRELATION INTERFEROMETER FOR THE CARBON MONOXIDE POLLUTION EXPERIMENT
 M. H. Bortner, R. Dick (Barringer Res., Ltd.), H. W. Goldstein, R. N. Grenda (Barringer Res., Ltd.), and G. M. Levy Mar. 1973 185 p refs
 (Contract NAS1-10139)
 (NASA-CR-112212) Avail: NTIS HC \$11.25 CSCL 14B

The breadboard model of the correlation interferometer for the Carbon Monoxide Pollution Experiment has been designed, fabricated, and tested. Laboratory, long-path, and atmospheric tests which were performed show the technique to be a feasible method for obtaining a global carbon monoxide map and a vertical carbon monoxide profile and similar information is readily obtainable for methane as well. In addition, the technique is readily applicable to other trace gases by minor instrumental changes. As shown by the results and the conclusions, it has been determined that CO and CH₄ data can be obtained with an accuracy of 10% using this technique on the spectral region around 2.3 microns. Author

N73-25484# Department of Housing and Urban Development, Washington, D.C.
[MAPPING, AERIAL PHOTOGRAPHY, AND GROUND SURVEYING RELATED TO URBAN PLANNING AND COMMUNITY DEVELOPMENT] Final Report
 15 Dec. 1972 115 p refs
 (PB-214305/5) Avail: NTIS HC \$3.00 CSCL 13B

The report contains information on urban mapping activities assisted in FY 1972 by the Department of Housing and Urban Development. At the request of the Office of Management and Budget, HUD has cooperated in a study by the Federal Mapping Task Force on how best to use government resources to fulfill present and future unmet needs in mapping, aerial photography, and ground surveying in connection with urban planning and community development. Author (GRA)

N73-25993# Metropolitan Washington Council of Governments, D.C.
URBAN IMPACT ON AREAS OF MAXIMUM ENVIRONMENTAL QUALITY WITHIN THE WASHINGTON METROPOLITAN AREA, 1971, VOLUME 4: SUPPLEMENT TO PRELIMINARY OPEN SPACE PLAN AND PROGRAM FOR METROPOLITAN WASHINGTON Final Report
 Aug. 1972 48 p
 (PB-214544/9) Avail: NTIS HC \$4.50 CSCL 13B

This report analyzes, utilizing high altitude imagery, the observable evidence of urban activity upon 176,000 acres of open space in the Washington, D.C. SMSA. GRA

N73-26330*# Dartmouth Coll., Hanover, N.H. Dept. of Geography.
LAND USE IN NORTHERN MEGALOPOLIS Progress

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Report

Robert B. Simpson, Principal Investigator 12 Jul. 1973 1 p
ERTS
(Contract NAS5-21749)
(E73-10723; NASA-CR-133087; PR-7) Avail: NTIS HC
\$3.00 CSCI 08B

N73-26331* Environmental Research Inst. of Michigan, Ann Arbor.
STUDY OF RECREATIONAL LAND AND OPEN SPACE USING SKYLAB IMAGERY Monthly Report, 7-31 May 1973

I. J. Sattinger, Principal Investigator 11 Jun. 1973 2 p
EREP
(Contract NAS9-13283)
(E73-10724; NASA-CR-133088; MR-1) Avail: NTIS HC
\$3.00 CSCI 08B

N73-26347* Vermont Univ., Burlington. Remote Sensing Lab.
POLLUTION MONITORING IN LAKE CHAMPLAIN USING ERTS-1 IMAGERY

A. O. Lind, Principal Investigator and E. B. Henson Jun. 1973
8 p Original contains imagery. Original photography may be purchased from EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(Contract NAS5-21753)
(E73-10742; NASA-CR-133086) Avail: NTIS HC \$3.00 CSCI 08H

The author has identified the following significant results. Band 4 imagery of April 7 and 25 show contrasting pollution effects due to seasonal and discharge variations. The pollution plume emanating from the International Paper Co. mill just north of Fort Ticonderoga was first detected on October 10 ERTS-1 imagery and now has been documented during spring high lake level conditions. The plume was observed extending further to the north and east than under low water conditions of October 10. This northward extension reflects a stronger northward current flow expected in the turbid southern leg of Lake Champlain. The extensive plume of April 25 represents full plant operation while the April 5 scene shows some plume traces directly over the submerged diffuser, discharge pipe representing minimal discharge during weekend plant operation. The ERTS-1 documentation will be used in developing a model of plume behavior under varying environmental conditions and will hopefully serve to assist in a major resource decision pending at U.S. Supreme Court level.

N73-27241* Kansas Univ. Center for Research, Inc., Lawrence.

AREA MEASUREMENT OF LAND USE CATEGORIES IN FINNEY COUNTY, KANSAS

Robert M. Haralick, Principal Investigator 24 Jan. 1973 5 p
ERTS
(Contract NAS5-21822)
(E73-10764; NASA-CR-132208) Avail: NTIS HC \$3.00 CSCI 08B

N73-27248* Cornell Univ., New York. Dept. of Natural Resources.

ERTS EVALUATION FOR LAND USE INVENTORY Progress Report, 13 Dec. 1972 - 13 Jun. 1973

Ernest E. Hardy, Principal Investigator 13 Jun. 1973 128 p
refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(Contract NAS5-21886)
(E73-10772; NASA-CR-133139) Avail: NTIS HC \$8.50 CSCI 08F

The author has identified the following significant results. The feasibility of accomplishing a general inventory of any given region based on spectral categories from satellite data has been demonstrated in a pilot study for an area of 6300 square kilometers

in central New York State. This was accomplished by developing special processing techniques to improve and balance contrast and density for each spectral band of an image scene to compare with a standard range of density and contrast found to be acceptable for interpretation of the scene. Diazo film transparencies were made from enlarged black and white transparencies of each spectral band. Color composites were constructed from these diazo films in combinations of hue and spectral bands to enhance different spectral features in the scene. Interpretation and data takeoff was accomplished manually by translating interpreted areas onto an overlay to construct a spectral map. The minimum area interpreted was 25 hectares. The minimum area geographically referenced was one square kilometer. The interpretation and referencing of data from ERTS-1 was found to be about 88% accurate for eight primary spectral categories.

N73-27255* Old Dominion Univ. Research Foundation, Norfolk, Va.

CORRELATION OF SATELLITE AND GROUND DATA IN AIR POLLUTION STUDIES Bimonthly Reports, 1 Feb. - 31 Mar. 1973 and 1 Apr. - 31 May 1973

G. E. Copeland, Principal Investigator, A. R. Bandy, R. N. Blais, and G. M. Hilton 31 May 1973 13 p ERTS
(Contract NAS5-21816)
(E73-10778; NASA-CR-133146) Avail: NTIS HC \$3.00 CSCI 04A

N73-27259* Environmental Research Inst. of Michigan, Ann Arbor.

STUDY OF RECREATIONAL LAND AND OPEN SPACE USING SKYLAB IMAGERY Monthly Report, 1-30 Jun. 1973

I. J. Sattinger 6 Jul. 1973 1 p EREP
(Contract NAS9-13283)
(E73-10783; NASA-CR-133150; MR-2) Avail: NTIS HC
\$3.00 CSCI 08F

N73-27266* Bureau of Reclamation, Denver, Colo.

APPLICATION OF REMOTE SENSING TO SELECTED BUREAU OF RECLAMATION PROJECTS Progress Report, 1 Jan. - 2 Jul. 1973

Larry D. Cast, Principal Investigator 2 Jul. 1973 4 p refs
ERTS
(NASA Order S-70243-AG)
(E73-10792; NASA-CR-133159) Avail: NTIS HC \$3.00 CSCI 08B

N73-27272* Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.

[DETECTION AND MONITORING OIL POLLUTION FROM SKYLAB EREP SENSORS] Quarterly Progress Report, 7 Mar. - 31 May 1973

Robert Horvath, Principal Investigator 12 Jun. 1973 2 p
EREP
(Contracts NAS9-13281; DOT-CG-24063-A)
(E73-10796; NASA-CR-133207; Rept-101800-4-L; QPR-1)
Avail: NTIS HC \$3.00 CSCI 08H

N73-27291* Oregon State Univ., Corvallis.

COMPARATIVE EVALUATION OF SPATIAL FEATURES IN AUTOMATIC LAND USE CLASSIFICATION FROM PHOTOGRAPHIC IMAGERY

James H. Herzog and Roy C. Rathja 17 Jul. 1973 9 p refs
Proposed for presentation at Conf. on Machine Processing of Remotely Sensed Data, Lafayette, Ind., 16-18 Oct. 1973 ERTS
(Contract NAS5-21831)
(E73-10816; NASA-CR-133310) Avail: NTIS HC \$3.00 CSCI 08B

N73-27296* Minnesota State Planning Agency, St. Paul.
APPLICATION OF ERTS-1 IMAGERY TO STATE WIDE LAND INFORMATION SYSTEM IN MINNESOTA Progress Report,

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Jan. - Jun. 1973

Joseph E. Sizer, Principal Investigator 20 Jul. 1973 48 p
ERTS
(Contract NAS5-21801)
(E73-10821; NASA-CR-133315) Avail: NTIS HC \$4.50 CSCL
08B

N73-27298* Earth Satellite Corp., Washington, D.C.
**SAMPLING STRATEGIES IN LAND USE MAPPING USING
SKYLAB DATA** Monthly Progress Report, Jun. 1973
David S. Simonett, Principal Investigator Jun. 1973 13 p
refs EREP
(Contract NAS9-13314)
(E73-10823; NASA-CR-133324) Avail: NTIS HC \$3.00 CSCL
08F

N73-27321# Florida Univ., Gainesville.
**REMOTE SENSING OF WATER QUALITY: A STATE OF
THE ART REPORT**
William J. Mitsch May 1973 15 p refs Supported in part
by the Dept. of Interior
(Publ-21) Avail: NTIS HC \$3.00

Remote sensing, or the carrying out of aerial or space surveys
of the earth's surface, is finding several applications in the fields
of water quality and water resource management. It offers a
means of obtaining large amounts of data, but its value is in
the expansion of data in the spatial, temporal and spectral modes.
The most valuable techniques presently are photography, infrared
scanning and multispectral scanning. Aircraft applications include
the measuring of the distribution of various waste discharges
into water bodies and the study of aquatic plant growth and
benthic communities. The ERTS program is investigating satellite
applications of monitoring the earth's resources, the satellite offers
the enhancement of data in the temporal mode with periodic
remote sensing of most of the earth's surface. Author

N73-27362# Edison Water Quality Lab., N.J.
**THE APPEARANCE AND VISIBILITY OF THIN OIL FILMS
ON WATER**
Aug. 1972 74 p refs
(PB-219825/7; W73-08295; EPA-R2-72-039) Avail: NTIS MF
\$0.95; SOD HC \$2.50 as EPI.23/2:72 039 CSCL 13B

The report examines the inherent optical characteristics and
corresponding inherent visual effects of thin films of oil on water.
The objective of the laboratory study is to determine the feasibility
of visual means of oil spill detection. Factors considered include
nature of illumination, sky conditions, sun angle, color and depth
of water, color of bottom, and viewing angle. GRA

N73-28266* Bendix Corp., Ann Arbor, Mich.
**ERTS-1 INVESTIGATION OF ECOLOGICAL EFFECTS OF
STRIP MINING IN EASTERN OHIO**
Philip E. Chase and Wayne Pettyjohn (Ohio State Univ.) In
NASA. Goddard Space Flight Center Symp. on Significant
Results obtained from the ERTS-1, Vol. 1, Sect. A and B. 1973
p 561-568 refs Original contains imagery. Original photography
may be purchased from the EROS Data Center, 10th and Dakota
Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-E2) CSCL 08I

Evidence is presented of ERTS capability to detect, map
and monitor the effects of strip mining. Both enlarge ERTS imagery
and statistically processed outline maps and imagery of stripped
earth and standing water are compared to aerial photos of a
strip mine near Coshocton, Ohio. The outline maps and decision
imagery are at present limited to forming a disruption map of
recently mined and unreclaimed earth and the resultant standing
water within the mined area. It is planned to prepare a map of
the reclaimed areas (reclamation map) within the stripped area
and to detect and identify ecological effects such as vegetation
kills and stream sedimentation external to the stripped areas.
Author

N73-28267* Pennsylvania State Univ., University Park. Office
of Remote Sensing of Earth Resources.

**THE USE OF ERTS-1 MSS DATA FOR MAPPING STRIP
MINES AND ACID MINE DRAINAGE IN PENNSYLVANIA**
S. S. Alexander, J. Dein, and D. P. Gold In NASA. Goddard
Space Flight Center Symp. on Significant Results obtained from
the ERTS-1, Vol. 1, Sect. A and B 1973 p 569-575 refs
erts
(Paper-E3) CSCL 08I

Digital processing of ERTS-1 MSS data for areas around
the west branch of the Susquehanna River permits identification
of stripped areas including ones that are not discernible from
visual analysis of ERTS imagery. Underflight data and ground-
based observations are used for ground-truth and as a basis for
designing more refined operators to make sub-classifications of
stripped areas, particularly with regard to manifestations of acid
mine drainage; because of associated diagnostic effects on
vegetation, seasonal changes in classification criteria are being
documented as repeated, cloud-free ERTS-1 coverage of the same
area becomes available. Preliminary results indicate that ERTS
data can be used to monitor not only the total extent of stripping
in given areas but also the effectiveness of reclamation and
pollution abatement procedures. Author

N73-28268* Spectral Africa (Pty) Ltd., Randfontein (Republic
of South Africa).

**MONITORING VEGETATION COVER ON MINE DUMPS
WITH ERTS-1 IMAGERY: SOME INITIAL RESULTS**
Brian Gilbertson In NASA. Goddard Space Flight Center Symp.
on Significant Results obtained from the ERTS-1, Vol. 1, Sect.
A and B 1973 p 577-584 Original contains imagery.
Original photography may be purchased from the EROS Data
Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-E4) CSCL 08I

ERTS-1 imagery is being used in an attempt to differentiate
between mine dumps having varying degrees of vegetative cover.
At this stage it is clear that the various mine dumps can be
located and identified. Differences in vegetative cover can be
seen and measured. Patterns of vegetative growth, some
characteristic to particular dumps, can also be seen. It is
therefore tentatively concluded that mine dumps can be
differentiated with respect to their vegetative cover on the imagery
received to date. Subsequent imagery showing seasonal variations
should facilitate this program. Author

N73-28269* Old Dominion Univ., Norfolk, Va. Dept. of
Geophysical Sciences.

REMOTE DETECTION OF AEROSOL POLLUTION BY ERTS
G. E. Copeland, A. R. Brandy, E. C. Kindle, R. N. Blais, and G.
M. Hilton In NASA. Goddard Space Flight Center Symp. on
Significant Results obtained from the ERTS-1, Vol. 1, Sect. A
and B 1973 p 585-592 ERTS

(Paper-E5) CSCL 04B

Photogrammetric and densitometric examination of ERTS-1
MSS imagery of Eastern Virginia coupled with extensive ground
truth air quality and meteorological data has shown that the
identification and surveying of fixed particulate emitters (smoke
plumes) is feasible. A description of the ground truth network is
included. The quantitative monitoring of smoke stacks from orbital
altitudes over state size regions appears possible when tied to
realistic plume models and minimal ground truth. Contrast
reductions over urban areas can possibly be utilized to produce
isopleths of particulates when supplemented by local measure-
ments. Author

N73-28273* Earth Satellite Corp., Washington, D.C.
**APPLICATION OF ERTS-1 DATA TO THE PROTECTION AND
MANAGEMENT OF NEW JERSEY'S COASTAL ENVIRON-
MENT**

Robert L. Mairs, Frank J. Wobber, Donald Garofalo, and Roland
Yunghans (N. J. Dept. of Environ. Protection) In NASA. Goddard
Space Flight Center Symp. on Significant Results obtained from
the ERTS-1, Vol. 1 Sect. A and B 1973 p 628-634 ERTS

02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

(Paper-E9) CSCL 08A

ERTS-1 imagery is being used by the New Jersey Department of Environmental Protection (NJDEP) to develop information products that will assist the state in optimally managing its coastal resources and in allocating funds. Interviews with NJDEP personnel have identified significant problem areas in the coastal zone, and the types of remote sensor derived information products that can be used in real-time decision making. Initial analyses of imagery from several successive ERTS-1 orbits have shown the extent, predominant drift, and dispersion characteristics of waste disposal in coastal New Jersey waters. Imagery (MSS Bands 4 and 5) for several orbits, shows that New-York Harbor tidal discharge extending as far south as Long Branch, New Jersey. Author

N73-28274* Environmental Research Inst. of Michigan, Ann Arbor.

MONITORING OCEAN DUMPING WITH ERTS-1 DATA

C. T. Wezernak and N. Roller /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1 Vol. 1, Sect. A and B 1973 p 635-641 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-E10) CSCL 08A

The results of an analysis of ERTS-1 data for the New York Bight collected on 18 August 1972 are described. Results are presented which show acid-iron wastes, sewage sludge, suspended solids, and major water mass boundary features in the study area. The potential of satellite remote sensing for monitoring large scale events such as ocean dumping is discussed. Author

N73-28275* Vermont Univ., Burlington.

ENVIRONMENTAL STUDY OF ERTS-1 IMAGERY: LAKE CHAMPLAIN AND VERMONT

Aulis O. Lind, E. Bennette Herson, and James Pelton /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 643-650 ref Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-E11) CSCL 08F

Environmental concerns of the State of Vermont currently being stressed include water quality in Lake Champlain and a state-wide land use and capability plan. Significant results obtained from ERTS-1 relate directly to the above concerns. Industrial water, pollution and turbidity in Lake Champlain have been identified and mapped and the ERTS pollution data will be used in the developing court suit which Vermont has initiated against the polluters. ERTS imagery has also provided a foundation for updating and revising land use inventories. Major classes of land use have been identified and mapped, and substantial progress has been made toward the mapping of such land use divisions as crop and forest type, and wetlands. Author

N73-28276* Kansas Univ., Lawrence.

WATER TURBIDITY DETECTION USING ERTS-1 IMAGERY

Harold L. Yarger, James R. McCauley, Gerard W. James, Larry M. Magnuson, and G. Richard Marzoff (Kansas State Univ.) /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 651-658 ERTS

(Contract NAS5-21822)

(Paper-E12) CSCL 08H

ERTS-1 images of two federal reservoirs in Kansas exhibit good correlation with suspended load. The major reservoirs in Kansas, as well as in other Great Plains states, are playing increasingly important roles in flood control, recreation, agriculture, and urban water supply. Satellite imagery may prove useful for acquiring timely low cost water quality data required for optimum management of these fresh water resources. Author

N73-28299* Geological Survey, Washington, D.C.

CHANGE IN LAND USE IN THE PHOENIX (1:250,000) QUADRANGLE, ARIZONA BETWEEN 1970 AND 1972: SUCCESSFUL USE OF PROPOSED LAND USE CLASSIFICATION SYSTEM

John L. Place /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 899-906 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-L3) CSCL 08B

Changes in land use in the Phoenix (1:250,000 scale) Quadrangle in Arizona have been mapped using only the images from ERTS-1, tending to verify the utility of a land use classification system proposed for use with ERTS images. The period of change investigated was from November 1970 to late summer or early fall, 1972. Seasonal changes also were studied using successive ERTS images. Types of equipment used to aid interpretation included a color additive viewer, a twenty-power magnifier, a density slicer, and a diazo copy machine for making ERTS color composites in hard copy. Types of changes detected have been: (1) cropland or rangeland developed for new residential areas; (2) rangeland converted to new cropland; and (3) possibly new areas of industrial or commercial development. A map of land use previously compiled from air photos was updated in this manner. Author

N73-28300* California Univ., Santa Barbara. Geography Remote Sensing Unit.

LAND USE INVESTIGATIONS IN THE CENTRAL VALLEY AND CENTRAL COASTAL TEST SITES, CALIFORNIA

John E. Estes /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 907-914 ERTS

(Paper-L4) CSCL 08B

The Geography Remote Sensing Unit (GRSU) at the University of California, Santa Barbara is responsible for investigations with ERTS-1 data in the Central Coastal Zone and West Side of the San Joaquin Valley. The nature of investigative effort involves the inventory, monitoring, and assessment of the natural and cultural resources of the two areas. Land use, agriculture, vegetation, landforms, geology, and hydrology are the principal subjects for attention. These parameters are the key indicators of the dynamically changing character of the areas. Monitoring of these parameters with ERTS-1 data will provide the techniques and methodologies required to generate the information needed by federal, state, county, and local agencies to assess change-related phenomena and plan for management and development. Author

N73-28301* California Univ., Riverside. Dept. of Geography.

LAND USE IN THE NORTHERN COACHELLA VALLEY

Jack B. Bale and Leonard W. Bowden /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 915-922 refs ERTS

(Paper-L5) CSCL 08B

Satellite imagery has proved to have great utility for monitoring land use change and as a data source for regional planning. In California, open space desert resources are under severe pressure to serve as a source for recreational gratification to individuals living in the heavily populated southern coastal plain. Concern for these sensitive arid environments has been expressed by both federal and state agencies. The northern half of the Coachella Valley has historically served as a focal point for weekend recreational activity and second homes. Since demand in this area has remained high, land use change from rural to urban residential has been occurring continuously since 1968. This area of rapid change is an ideal site to illustrate the utility of satellite imagery as a data source for planning information, and has served as the areal focus of this investigation. Author

N73-28302* Geological Survey, Washington, D.C.
LAND USE CLASSIFICATION AND CHANGE ANALYSIS USING ERTS-1 IMAGERY IN CARETS

Robert H. Alexander *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 923-930 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-L6) CSCL 08B

Land use detail in the CARETS area obtainable from ERTS exceeds the expectations of the Interagency Steering Committee and the USGS proposed standardized classification, which presents Level 1 categories for ERTS and Level 2 for high altitude aircraft data. Some Levels 2 and 3, in addition to Level 1, categories were identified on ERTS data. Significant land use changes totaling 39.2 sq km in the Norfolk-Portsmouth SMSA were identified and mapped at Level 2 detail using a combination of procedures employing ERTS and high altitude aircraft data.

Author

N73-28303* Geological Survey, Washington, D.C.
ERTS REGIONAL SCALE OVERVIEW LINKING LAND USE AND ENVIRONMENTAL PROCESSES IN CARETS

Robert H. Alexander *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 931-937 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-L7) CSCL 08B

A mosaic of ERTS images of the CARETS region has been used to partition the region into zones on the basis of similarity of tones and textures visible at a regional-scale overview. The resulting patterns were compared with existing small scale maps of the region representing relief, land surface forms, geology, soils, vegetation, forest types, and land use. The ERTS-derived zones most closely resemble the patterns on the small scale land use map, suggesting that, at least in a highly developed region such as CARETS, land use is an indicator or resultant surface expression of several interacting environmental processes. These results lend support to the CARETS model of interdisciplinary regional analysis, whereby remote sensor-derived data sets on land use and land use change become the basic data entry into a regional information system to serve regional planners and land managers.

Author

N73-28304* Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
EVALUATION OF LAND USE MAPPING FROM ERTS IN THE SHORE ZONE OF CARETS

Robert Dolan and Linwood Vincent *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-L8) CSCL 08B

Imagery of the Atlantic shoreline zone of the Central Atlantic Regional Ecological Test Site (CARETS) was evaluated for classifying land use and land cover, employing the USGS Geographic Application Program's land use classification system. ERTS data can provide a basis for land cover and land use mapping within the shoreline zone, however because of the dynamic nature of this environment, two additional terms are considered: vulnerability of classes to storms and progressive erosion, and sensitivity of the classes to man's activities. Author

N73-28308* Dartmouth Coll., Hanover, N.H.
LAND USE OF NORTHERN MEGALOPOLIS

Robert B. Simpson and David T. Lindgren *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 973-980 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls,

S. D. 57198 ERTS
 (Paper-L12) CSCL 08B

The major objective is to map and digitize the land use of northern megalopolis, the states of Massachusetts, Connecticut, and Rhode Island, and to evaluate ERTS as a planning tool for megalopolitan areas. The southern New England region provides a good test ERTS's capabilities because of its complex landscape. Not only are there great differences in the degree of urban development, but in relief and vegetative cover as well. Author

N73-28309* Wyoming Univ., Laramie. Dept. of Geology.
REMOTE SENSING APPLIED TO LAND-USE STUDIES IN WYOMING

Roy M. Breckenridge, Ronald W. Marrs, and Donald J. Murphy *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 981-989 ERTS

(Paper-L13) CSCL 08B

Impending development of Wyoming's vast fuel resources requires a quick and efficient method of land use inventory and evaluation. Preliminary evaluations of ERTS-1 imagery have shown that physiographic and land use inventory maps can be compiled by using a combination of visual and automated interpretation techniques. Test studies in the Powder River Basin showed that ERTS image interpretations can provide much of the needed physiographic and land use information. Water impoundments as small as one acre were detected and water bodies larger than five acres could be mapped and their acreage estimated. Flood plains and irrigated lands were successfully mapped, and some individual crops were identified and mapped. Coniferous and deciduous trees were mapped separately using color additive analysis on the ERTS multispectral imagery. Gross soil distinctions were made with the ERTS imagery, and were found to be closely related to the bedrock geology. Several broad unstable areas were identified. These were related to specific geologic and slope conditions and generally extended through large regions. Some new oil fields and all large open-cut coal mines were mapped. The most difficult task accomplished was that of mapping urban areas. Work in the urban areas provides a striking example of snow enhancement and the detail available from a snow enhanced image.

Author

N73-28310* Minnesota Univ., Minneapolis. Dept. of Geography.
ERTS-1 APPLICATIONS TO MINNESOTA LAND USE MAPPING

Dwight Brown, James Gamble, Steven Prestin, Dale Trippler, Merle Meyer, Joseph Ulliman, and Ralph Eller *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 991-997 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-L14) CSCL 08B

Land use class definitions that can be operationally employed with ERTS-1 imagery are being developed with the cooperation of personnel from several state, regional, and federal agencies with land management responsibilities within the state and the University of Minnesota. Investigations of urban, extractive, forest, and wetlands areas indicate that it is feasible to subdivide each of these classes into several sub-classes with the use of ERTS-1 images from one or more time periods.

Author

N73-28311* Wisconsin Univ., Madison.
THE USE OF ERTS-1 DATA FOR THE INVENTORY OF CRITICAL LAND RESOURCES FOR REGIONAL LAND USE PLANNING

J. L. Clapp, R. W. Kiefer, M. M. McCarthy, and B. J. Niemann, Jr. *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1007-1014 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-L16) CSCL 08B

02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

Computer-generated spatial and statistical comparisons of critical land resource data derived from conventional sources, RB-57 photographs, and ERTS images, for an eastern Wisconsin test site, suggest that certain critical land resource data can be mapped from ERTS images on a statewide basis. This paper presents one of the biotic resources, wetlands, as an example of the use of ERTS imagery to inventory land resources. Author

N73-28312* Pennsylvania State Univ., University Park. Office for Remote Sensing of Earth Resources.

INVESTIGATIONS OF AN URBAN AREA AND ITS LOCALE USING ERTS-1 DATA SUPPORTED BY U-PHOTOGRAPHY
H. A. Weeden, F. Y. Borden, D. N. Applegate, and N. Bolling
In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1015-1022 refs Prepared for Mitre Corp., Bedford, Mass. ERTS

(Contracts NAS5-23133; MITRE-N-35490)

(Paper-L17) CSDL 08B

An urban area in central Pennsylvania and the surrounding locality were investigated separately at first by photointerpretation of ERTS-1 imagery and by computer processing of MSS tapes. Next the photointerpretation and processing were coordinated. The results of the cooperative effort of photointerpreters and computer processing analysts were much improved over independent efforts. It was found that single frames of U-2 photography could be projected onto printer output maps with little recognizable distortion in areas 10 to 25 cm square. In this way targets could be identified for use as training areas for computer processed signature identification. In addition, at any stage of category mapping, the level of success in correct classification could be assessed by this method. The results of the classification of the study area are discussed. Author

N73-28313* General Electric Co., Philadelphia, Pa. Space Div.

FIRST LOOK ANALYSES OF FIVE CYCLES OF ERTS-1 IMAGERY OVER COUNTY OF LOS ANGELES: ASSESSMENT OF DATA UTILITY FOR URBAN DEVELOPMENT AND REGIONAL PLANNING

S. Raje, R. Economy, and J. McKnight (Los Angeles County Regional Planning Comm.) *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1023-1030 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-L18) CSDL 08B

Significant results have been obtained from the analyses of ERTS-1 imagery from five cycles over Test Site SR 124 by classical photointerpretation and by an interactive hybrid multispectral information extraction system (GEMS). The synopticity, periodicity and multispectrality of ERTS coverage, available for the first time to LA County planners, have opened up both a new dimensionality in data and offer new capability in preparation of planning inputs. Photointerpretation of ERTS images has produced over 25 overlays at 1:1,000,000 scale depicting regional relations and urban structure in terms of several hundred linear and areal features. To mention only one such result, a possible new fault lineament has been discovered on the northern slope of the Santa Monica mountains in the scene 1144-18015, composited of MSS bands 4, 5, 6. GEMS analysis of the ERTS products has provided new or improved information in the following planning data categories: urban vegetation; land cover segregation; man-made and natural impact monitoring; urban design; and suitability. ERTS data analysis has allowed planners to establish trends that directly impact planning policies. This new source of information will not only assist current methods to be more efficient, but permits entirely new planning methodologies to be employed. Author

N73-28314* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

PREPARATION OF URBAN LAND USE INVENTORIES BY MACHINE PROCESSING OF ERTS MSS DATA

William Todd, Paul Mausel, and Kenneth Wenner *In* NASA.

Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1031-1039 ref Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-L19) CSDL 05B

Spectral classes of urban phenomena identified from Earth Resources Technology Satellite (ERTS) multispectral scanner data in Milwaukee included suburban inner city, industry, grassy (open area), road, wooded suburb, water cloud, and shadow. The Milwaukee spectral class statistics were used to classify the Chicago area, within the same ERTS frame, and similar results were achieved. In another ERTS frame, Marion County (Indianapolis) data were classified into similar classes. The Marion County ERTS study was supported by a land use classification of an area near downtown Indianapolis that utilized 12-band MSS data collected by aircraft from 3000 feet. The results of the ERTS analyses suggest that satellite data will be a useful tool for the urban planner for monitoring urban land use. Author

N73-28315* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

A COMPARISON OF LAND-USE DETERMINATIONS USING DATA FROM ERTS-1 AND HIGH ALTITUDE AIRCRAFT
M. Ann Lundelius (Lockheed Electron. Co., Inc., Houston, Tex.), C. Mark Chestnutwood, Joe G. Garcia, and R. Bryan Erb *In* its Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1041-1046 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-L20) CSDL 08B

A manual interpretation of ERTS-1 MSS system corrected imagery has been performed on a study area within the Houston Area Test Site to classify land use using the Level 1 categories proposed by the Department of the Interior. The two types of imagery used included: (1) black and white transparencies of each band enlarged to a scale of approximately 1:250,000 and (2) color transparencies composited from the computer compatible tapes using the film recorder on a multispectral data analysis station. The results of this interpretation have been compared with the 1970 land use inventory of HATS which was compiled using color Ektachrome imagery from high altitude aircraft (scale 1:120,000). Urban data from the same scene was also analyzed using a computer-aided (clustering) technique. The resulting clusters, representing areas of similar content, were compared with existing land use patterns in Houston. A technique was developed to correlate the spectral clusters to specific urban features on aircraft imagery by the location of specific, high contrast objects in particular resolution elements. It was concluded that ERTS-1 data could be used to develop Level 1 and many Level 2 land use categories for regional inventories and perhaps to some degree on a local level. Author

N73-28316* Environmental Research Inst. of Michigan, Ann Arbor.

DIGITAL LAND USE MAPPING IN OAKLAND COUNTY, MICHIGAN

Irvin J. Sattinger and Robert D. Dillman *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1047-1054 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-L21) CSDL 08B

ERTS-1 data for a portion of Oakland County, Michigan was computer processed to produce a map of water, urban areas, wooded areas, and other vegetation. Comparison with RB-57 photography of the area shows a good correspondence of the two sources of data. Preliminary evaluation indicates that this type of four-category map derived from ERTS data will be useful for conceptual studies of large geographic areas in recreational planning. Author

N73-28321* Environmental Research Inst. of Michigan, Ann Arbor.

LAND RESOURCES SURVEY FOR THE STATE OF MICHIGAN

Buzz Sellman *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1083-1090 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-L26) CSCL 08F

The usefulness of ERTS-1 satellite imagery as an information source for a statewide inventory of Michigan's land resources is documented. The project is currently relying on photointerpretation of MSS photography and computed processed results. The first task completed was a 1:500,000 scale land use map of the state in four classes: urban, forest, water, and agriculture and other. This map was constructed from existing (pre-ERTS-1) information sources including federal, state and county maps, and aerial photography. An ERTS color IR photomosaic for the entire state will also be constructed at a scale of 1:250,000. The Institute is currently working on tape processed data that will include both recognition data as well as a UTM coordinate addressing capability so that the final tape can be input directly into computerized land use and transportation corridor analysis models. Author

N73-28362* California Univ., Riverside. Dept. of Geography. **ASSESSMENT OF SOUTHERN CALIFORNIA ENVIRONMENT FROM ERTS-1**

Lzonard W. Bowden and James H. Viellnava *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1467-1474 ERTS

(Paper-R4) CSCL 08F

ERTS-1 imagery is a useful source of data for evaluation of earth resources in Southern California. The improving quality of ERTS-1 imagery, and our increasing ability to enhance the imagery has resulted in studies of a variety of phenomena in several Southern California environments. These investigations have produced several significant results of varying detail. They include the detection and identification of macro-scale tectonic and vegetational patterns, as well as detailed analysis of urban and agricultural processes. The sequential nature of ERTS-1 imagery has allowed these studies to monitor significant changes in the environment. In addition, some preliminary work has begun directed toward assessing the impact of expanding recreation, agriculture and urbanization into the fragile desert environment. Refinement of enhancement and mapping techniques and more intensive analysis of ERTS-1 imagery should lead to a greater capability to extract detailed information for more precise evaluations and more accurate monitoring of earth resources in Southern California. Author

N73-28373* Mitre Corp., McLean, Va. **AIR QUALITY INDICES FROM ERTS-1 MSS INFORMATION**

Ellen L. Riley, Steven Stryker, and Edward A. Ward *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1583-1591 refs ERTS

CSCL 04B

Comparison between ground based atmospheric turbidity network measurements and the average scene grayness from MSS Channel 4 data is in progress. Correlation between these two sources is promising. If continued correlation occurs for other ERTS-1 overflight dates and ground test sites, a new operational use of ERTS-1 useful to Federal, state, and international organizations will become available. Author

N73-28377* Metropolitan Washington Council of Governments, D.C. Remote Sensing Project.

USE OF ERTS-1 DATA FOR REGIONAL PLANNING IN THE METROPOLITAN WASHINGTON COUNCIL OF GOVERNMENTS: A SHORT BRIEF

Harry J. Mallon *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1613-1624 refs ERTS

CSCL 05A

Land use and land use activity changes over discrete intervals of time represent basic data requirements in regional planning studies. Two examples of land use analysis required by the Council of Governments' transportation planning staff are described. Both were undertaken utilizing remote sensing imagery analysis. One study using large scale aircraft imagery developed a high degree of analytical detail and functional identification. The other, to support further detailed data base evaluation, utilizing ERTS-1 and small scale aircraft imagery, developed data identifying in more general detail major activity changes within the metropolitan region. Author

N73-28378* Alabama Univ., University. Dept. of Civil and Mineral Engineering.

LAND USE MAPPING AND CHANGE DETECTION USING ERTS IMAGERY IN MONTGOMERY COUNTY, ALABAMA

Richard Paul Wilms *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1625-1633 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

CSCL 08B

The feasibility of using remotely sensed data from ERTS-1 for mapping land use and detecting land use change was investigated. Land use information was gathered from 1964 air photo mosaics and from 1972 ERTS data. The 1964 data provided the basis for comparison with ERTS-1 imagery. From this comparison, urban sprawl was quite evident for the city of Montgomery. A significant trend from forestland to agricultural was also discovered. The development of main traffic arteries between 1964 and 1972 was a vital factor in the development of some of the urban centers. Even though certain problems in interpreting and correlating land use data from ERTS imagery were encountered, it has been demonstrated that remotely sensed data from ERTS is useful for inventorying land use and detecting land use change. Author

N73-28379* Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.

DETERMINATION OF LAND USE IN MINNESOTA BY AUTOMATIC INTERPRETATION OF ERTS MSS DATA

Raymond E. Zirkle and Deborah R. Pile *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1635-1639 Prepared in cooperation with Minnesota Univ., St. Paul ERTS

CSCL 05B

This program aims to determine the feasibility of identifying land use in Minnesota by automatic interpretation of ERTS-MSS data. Ultimate objectives include establishment of land use delineation and quantification by computer processing with a minimum of human operator interaction. This implies not only that reflectivity as a function of calendar time can be catalogued effectively, but also that the effects of uncontrolled variables can be identified and compensated. Clouds are the major uncontrollable data pollutant, so part of the initial effort is devoted to determining their effect and the construction of a model to help correct or justifiably ignore affected data. Other short range objectives are to identify and verify measurements giving results of importance to land managers. Lake-counting is a prominent example. Open water is easily detected in band 7 data with some support from either band 4 or band 5 to remove ambiguities. Land managers and conservationists commission studies periodically to measure water bodies and total water count within specified areas. Author

N73-28397* Dartmouth Coll., Hanover, N.H.

LAND USE AND MAPPING

David T. Lindgren and Robert B. Simpson *In* NASA. Goddard

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Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 2 May 1973 p 100-105 Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
CSCL 08B

From the standpoint of technology, the most encouraging thing about ERTS has been the level of land-use identification. Land-use detail has exceeded the expectations of the Interagency Steering Committee and the requirements of land-use classification proposed by the Department of Interior. Whereas in the latter instance it was anticipated that only nine classes of land use would probably be identifiable, in fact some 14 to 18 classes have been identified. The success in the level of land-use identification results primarily from the various attributes of the ERTS system. These include the ability to provide repetitive coverage, and in particular seasonal coverage; the ability to image in four bands of the electromagnetic spectrum (green, red, and two near-infrared), which allows for manipulation of various combinations of bands; and the provision by the ERTS system of computer-compatible tapes for machine processing of data. Furthermore, the resolution of ERTS imagery has been better than expected. Although there is some question as to its exact resolving power, it is safe to say objects as small as 100 meters (300 feet) in diameter have been identified. Linear features as narrow as 16 meters (50 feet) can be detected. Author

N73-28407* Mississippi Test Facility, Bay St. Louis.

LAND USE AND MAPPING

D. Wayne Mooneyhan *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 3 May 1973 p 19-29 refs ERTS

CSCL 08B

Applications of ERTS-1 data and imagery in the fields of land use and mapping are summarized. Three areas are investigated and discussed: (1) mapping investigations; (2) land use inventory/image interpretation techniques; and (3) land use investigations/automatic pattern recognition techniques. A.L.

N73-28409* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ENVIRONMENT SURVEYS

Louis S. Walter *In* its Symp. on Significant Results obtained from the ERTS-1, Vol. 3 May 1973 p 47-56 refs ERTS

CSCL 13B

The applications of ERTS-1 in the investigation of environmental quality and pollution are reviewed. Problem areas discussed are: (1) air pollution; (2) water pollution; (3) land pollution; and (4) aesthetics. A.L.

N73-28417* Earth Satellite Corp., Berkeley, Calif.

A SCHEME FOR THE UNIFORM MAPPING AND MONITORING OF EARTH RESOURCES AND ENVIRONMENTAL COMPLEXES USING ERTS-1 IMAGERY Progress Report, 1 Jan. - 30 Jun. 1973

Charles E. Poulton, Principal Investigator 31 Jul. 1973 41 p Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (Contract NAS5-21830) (E73-10839; NASA-CR-133399; PR-2) Avail: NTIS HC \$4.25 CSCL 08B

N73-28423* Earth Satellite Corp., Washington, D.C.

APPLICATION OF ERTS-1 DATA TO THE PROTECTION AND MANAGEMENT OF NEW JERSEY'S COASTAL ENVIRONMENT Progress Report, Jan. - Jul. 1973

Roland S. Yunghans, Principal Investigator, Edward B. Feinberg, Robert L. Mairs, Frank J. Wobber, Kenneth R. Martin, Lawrence R. Pettinger, and Robert T. Macomber Jul. 1973 151 p Prepared for New Jersey Dept. of Environmental Protection, Trenton Original contains color imagery. Original photography may be

purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (Contract NAS5-21765) (E73-10845; NASA-CR-133424; ESC-304) Avail: NTIS HC \$9.75 CSCL 08C

The author has identified the following significant results. Analysis of ERTS-1 imagery and complementary aircraft overflights has led to the development of seventeen information products that are being utilized within the Department of Environmental Protection as new sources of information for coastal zone management. Problem areas of significance to the State, and in which product development has contributed to date, have been identified as: the environmental effects of offshore waste disposal, the placement of ocean outfalls, the better understanding of littoral processes for shore protection, the delineation of the coastal ecotones, and determination of the flushing characteristics of the State's estuaries. Of equal importance has been the development of a capability within the State to use and understand remote sensor-derived information.

N73-28433* Maine State Highway Dept., Bangor.

DETECTION AND MONITORING VEGETATION DAMAGE ASSOCIATED WITH HIGHWAY FACILITIES Progress Report, period ending 1 Jul. 1973

E. G. Stoeckeler, Principal Investigator Jul. 1973 3 p ERTS (Contract NAS5-21724) (E73-10856; NASA-CR-133444; PR-7) Avail: NTIS HC \$3.00 CSCL 08F

N73-29224* Maryland Dept. of State Planning, Baltimore. INVESTIGATION OF APPLICATION OF ERTS-A DATA TO INTEGRATED STATE PLANNING IN MARYLAND Progress Report, period ending 31 Jul. 1973

Edwin L. Thomas, Principal Investigator 31 Jul. 1973 4 p ERTS

(Contract NAS5-21779) (E73-10873; NASA-CR-133386; PR-5) Avail: NTIS HC \$3.00 CSCL 08F

N73-29233* Corps of Engineers, Champaign, Ill.

EFFECTS OF CONSTRUCTION AND STAGED FILLING OF RESERVOIRS ON THE ENVIRONMENT AND ECOLOGY Progress Report, 9 Jun. - 8 Aug. 1973

Ravinder K. Jain, Principal Investigator 8 Aug. 1973 1 p ERTS

(NASA Order S-70255-AG) (E73-10882; NASA-CR-133518) Avail: NTIS HC \$3.00 CSCL 08H

N73-29241* Army Construction Engineering Research Lab., Champaign, Ill. Environmental Systems Branch.

ENVIRONMENTAL AND ECOLOGICAL IMPACT OF MAJOR CONSTRUCTION Progress Report

Ravinder K. Jain, Principal Investigator 22 Aug. 1973 3 p EREP

(NASA Order T-4643-B) (E73-10892; NASA-CR-133551; PR-1) Avail: NTIS HC \$3.00 CSCL 13B

N73-29255* Mississippi State Univ., State College.

STUDY OF APPLICATION OF REMOTE SENSING DATA TO LAND USE PLANNING ON THE MISSISSIPPI GULF COAST Interim Report, Jan. - Aug. 1973

Franklin M. Ingels, Principal Investigator and Robert W. Boyd Aug. 1973 7 p ERTS (Contract NAS5-21817)

(E73-10906; NASA-CR-133563) Avail: NTIS HC \$3.00 CSCL 08J

The author has identified the following significant results. This project is currently involved in making visits to state and county agencies to obtain their reactions and opinions to the Mississippi Gulf Coast ERTS-1 data. The data products being used in these interviews are produced by NASA/MTF-ERL and consist of computer plotted maps with eight classifications and a statistical summary in booklet form. Reaction by potential users

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has been very favorable, but cost will be the largely determining factor in their ability to utilize ERTS-1 data in a recurring manner.

N73-29258* Maine State Highway Dept., Bangor.
[MULTIDISCIPLINARY ANALYSES FOR HIGHWAY ENGINEERING PURPOSES] Quarterly Progress Report, 18 May - 18 Aug. 1973
Ernest G. Stoeckeler, Principal Investigator 24 Aug. 1973 2 p
EREP
(Contract NAS9-13359)
(E73-10909; NASA-CR-133566; QPR-1) Avail: NTIS HC \$3.00 CSCL 08B

N73-29262* Earth Satellite Corp., Washington, D.C.
SAMPLING STRATEGIES IN LAND USE MAPPING USING SKYLAB DATA Monthly Progress Report, Jul. 1973
David S. Simonett, Principal Investigator Jul. 1973 6 p
EREP
(Contract NAS9-13314)
(E73-10913; NASA-CR-133570; MPR-2) Avail: NTIS HC \$3.00 CSCL 08B

N73-29264* Environmental Research Inst. of Michigan, Ann Arbor.
STUDY OF RECREATIONAL LAND AND OPEN SPACE USING SKYLAB IMAGERY Monthly Report, 1-31 Jul. 1973
Irvin J. Sattinger, Principal Investigator 14 Aug. 1973 2 p
EREP
(Contract NAS9-13283)
(E73-10915; NASA-CR-133572; MR-3) Avail: NTIS HC \$3.00 CSCL 08B

N73-29385* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
AN ANALYSIS OF MILWAUKEE COUNTY LAND USE
W. Todd and P. Mausel (Ind. State Univ.) Feb. 1973 31 p
reft
(Grant NGL-15-005-112)
(NASA-CR-133643; LARS-Inform-Note-022773) Avail: NTIS HC \$3.75 CSCL 05B

The identification and classification of urban and suburban phenomena through analysis of remotely-acquired sensor data can provide information of great potential value to many regional analysts. Such classifications, particularly those using spectral data obtained from satellites such as the first Earth Resources Technology Satellite (ERTS-1) orbited by NASA, allow rapid frequent and accurate general land use inventories that are of value in many types of spatial analyses. In this study, Milwaukee County, Wisconsin was classified into several broad land use categories on the basis of computer analysis of four bands of ERTS spectral data (ERTS Frame Number E1017-16093). Categories identified were: (1) road-central business district, (2) grass (green vegetation), (3) suburban, (4) wooded suburb, (5) heavy industry, (6) inner city, and (7) water. Overall, 90 percent accuracy was attained in classification of these urban land use categories. Author

N73-29414 Cornell Univ., Ithaca, N.Y.
AN EVALUATION OF THE IMPACT OF A HIGHWAY ON A RURAL ENVIRONMENT IN THAILAND BY AERIAL PHOTOGRAPHIC METHODS Ph.D. Thesis
Heng Liong Thung 1972 153 p
Avail: Univ. Microfilms Order No. 73-10147

This research was conducted in Thailand to assess the impact of a newly constructed highway through an undeveloped region, and to evaluate the use of aerial photographic analysis for data collection as a substitute for costly field operation in areas where statistical data is unavailable. Without the use of aerial photography this analysis and the conclusions could not have been made, because statistical data was unavailable or inaccurate. It has been demonstrated that the aerial survey can provide the regional planner with adequate information for assessing and

planning programs for development. The method allows rapid collection of resources information, which can be conducted in a fraction of the time and cost of a field party: Dissert. Abstr.

N73-29418* TRI-State Regional Planning Commission, New York.
INVESTIGATION OF SKYLAB IMAGERY FOR REGIONAL PLANNING Quarterly Progress Report
William Harting, Principal Investigator 20 Aug. 1973 1 p
EREP
(Contract NAS9-13266)
(E73-10886; NASA-CR-133524) Avail: NTIS HC \$3.00 CSCL 13B

N73-29989* Mississippi State Univ., State College. Dept. of Civil Engineering.
REMOTE SENSING APPLICATIONS FOR TRANSPORTATION AND TRAFFIC ENGINEERING STUDIES: A REVIEW OF THE LITERATURE
James W. Epps Jun. 1973 70 p refs
(Contract NAS8-29038)
(NASA-CR-129011) Avail: NTIS HC \$5.50 CSCL 13F

Current references were surveyed for the application of remote sensing to traffic and transportation studies. The major problems are presented that concern traffic engineers and transportation managers, and the literature references that discuss remote sensing applications are summarized. Author

N73-30297* Geological Survey, Washington, D.C. Geographic Applications Program.
LAND USE MAPPING AND MODELLING FOR THE PHOENIX QUADRANGLE Progress Report, 1 Jan. - 30 Jun. 1973
John L. Place, Principal Investigator 1 Jul. 1973 7 p ERTS (NASA Order S-70243-AG)
(E73-10955; NASA-CR-133631) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. The land use of the Phoenix Quadrangle in Arizona had been mapped previously from aerial photographs and recorded in a computer data bank. During the ERTS-1 experiment, changes in land use were detected using only the ERTS-1 images. The I2S color additive viewer was used as the principal image enhancement tool, operated in a multispectral mode. Hard copy color composite images of the best multiband combinations from ERTS-1 were made by photographic and diazo processes. The I2S viewer was also used to enhance changes between successive images by quick flip techniques or by registering with different color filters. More recently, a Bausch and Lomb zoom transferscope has been used for the same purpose. Improved interpretation of land use change resulted, and a map of changes within the Phoenix Quadrangle was compiled. The first level of a proposed standard land use classification system was successfully used. ERTS-1 underflight photography was used to check the accuracy of the ERTS-1 image interpretation. It was found that the total areas of change detected in the photos were comparable with the total areas of change detected in the ERTS-1 images.

N73-30306* Cornell Univ., Ithaca, N.Y. Dept. of Natural Resources.
EVALUATION OF SATELLITE IMAGERY AS AN INFORMATION SERVICE FOR INVESTIGATING LAND USE AND NATURAL RESOURCES (SKYLAB) Progress Report, 1-13 Aug. 1973
Ernest E. Hardy, Principal Investigator 31 Aug. 1973 1 p
EREP
(Contract NAS9-13364)
(E73-10964; NASA-CR-133650) Avail: NTIS HC \$3.00 CSCL 14E

N73-30307* Minnesota State Planning Agency, St. Paul.
LAND USE MANAGEMENT IN MINNESOTA Progress Report, 1 Jul. - 31 Aug. 1973
Joseph E. Sizer, Principal Investigator 6 Sep. 1973 9 p
ERTS

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(Contract NAS5-21801)
(E73-10965; NASA-CR-133744) Avail: NTIS HC \$3.00 CSCL 08B

N73-30312* Kansas Univ. Center for Research, Inc., Lawrence.

THE INFLUENCE OF IMAGE POSITION ON URBAN PLACE DETECTION

Robert M. Haralick, Principal Investigator 14 Jan. 1973 9 p ref ERTS

(Contract NAS5-21822)

(E73-10971; NASA-CR-133750) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. The ability of ERTS-1 MSS imagery to detect small urban places appears to vary with the position of the place in the image, as well as from band to band. Urban places of smallest size (approximately 2000 population) seem more detectable in the westernmost 3.5 degree scan segment. A relationship may exist between shadowing of vertical features and detectability.

N73-30315* Kansas Univ. Center for Research, Inc., Lawrence.

URBAN STREET PATTERNS DETECTABLE FROM ERTS-1

Stan A. Morain, Principal Investigator and Donald L. Williams 13 Apr. 1973 3 p ERTS

(Contract NAS5-21822)

(E73-10978; NASA-CR-133755) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. The major street patterns in Lincoln, Nebraska, are detectable on the January 24, 1973 ERTS MSS-4 image. To further study and identify the street patterns, a 3x Polaroid enlargement was made of the city from the image. An overlay of the enlargement was used to map the street patterns, with reference to the original image for clarity. The technique seems to be adaptable for updating standard road maps.

N73-30372* Wisconsin Univ., Madison. Space Science and Engineering Center.

RESEARCH ON THE OPTICAL STATE OF THE ATMOSPHERE, 1 AUGUST 1971 - 1 JUNE 1972

Michael McClintock, Alden McLellan, and Leaf Turner 30 Nov. 1972 60 p refs

(Contract EPA-68-02-0337)

(PB-220394/1; EPA-R3-72-027) Avail: NTIS HC \$3.00

Research is reported on the feasibility of using satellite-based instruments to detect atmospheric pollution. The report, which consists of three papers, investigates the possibility of climatic change from the radiative interference from dust and clouds in the atmosphere; provides an example of satellite detection of global or large-scale atmospheric pollution and a laboratory experiment on the non-lambertian radiative reflection properties of urban areas; and presents a theoretical treatment of electro-magnetic scattering from randomly oriented anisotropic particles with the intent of obtaining information about their shape. Author (GRA)

N73-31285* Environmental Research Inst. of Michigan, Ann Arbor.

STUDY OF RECREATIONAL LAND AND OPEN SPACE USING SKYLAB IMAGERY Monthly Report, 1-31 Aug. 1973

I. J. Sattinger, Principal Investigator 12 Sep. 1973 1 p EREP

(Contract NAS9-13283)

(E73-10973; NASA-CR-133752; MR-4) Avail: NTIS HC \$3.00 CSCL 08B

N73-31293* TRI-State Regional Planning Commission, New York.

INVESTIGATION OF SATELLITE IMAGERY FOR REGIONAL PLANNING: VISUAL INTERPRETATION OF BLACK/WHITE IMAGES AT 1:1000000 Progress Report

William Harting, Principal Investigator 7 Sep. 1973 13 p ERTS

(Contract NAS5-21738)

(E73-10988; NASA-CR-133766; PR-2) Avail: NTIS HC \$3.00 CSCL 08B

N73-31294* State of Ohio Dept. of Development, Columbus. RELEVANCE OF ERTS TO THE STATE OF OHIO Progress Report, Jul. - Aug. 1973

David C. Sweet, Principal Investigator Aug. 1973 33 p ref Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21782)

(E73-10987; NASA-CR-133766) Avail: NTIS HC \$3.75 CSCL 08F

The author has identified the following significant results. A significant result was the fabrication of an image transfer and comparison device. To avoid problems and high costs encountered in manual drafting methods, Battelle staff members have fabricated an inexpensive, yet effective, technique for transferring ERTS-1 analysis displays from the Spatial Data 32-Color Viewer to maps and/or aircraft imagery. In brief, the image transfer-comparison device consists of a 2-way mirror which functions similar to a zoom transfer scope. However, the device permits multiuser viewing and real time photographic recording (35-mm and Polaroid) of enhanced ERTS-1 imagery superimposed over maps and aircraft photography. Thirty-five mm, 70 mm, and 4 in. x 5 in. photographs are taken of 80% of the TV screen of the Spatial Data Density Slicing Viewer. The resulting black and white and color imagery is then used in transparent overlays, viewgraphs, 35-mm and 70-mm transparencies, and paper prints for reports and publications. Annotations can be added on the TV screen or on the finished product.

N73-31295* General Electric Co., Philadelphia, Pa. Space Div.

ANALYSES AND APPLICATIONS OF MULTIPLE CYCLES OF ERTS-1 IMAGERY OVER COUNTY OF LOS ANGELES: ASSESSMENT OF DATA UTILITY FOR URBAN DEVELOPMENT AND REGIONAL PLANNING

Surendra Anant Raja, Principal Investigator, Richard Economy, Jene McKnight (Los Angeles County Reg. Planning Comm., Calif.), Darryl Goehring (Los Angeles County Reg. Planning Comm., Calif.), and Gerald Willoughby (OVAACB Intern., Inc.) [1973] 18 p ref Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21797)

(E73-10989; NASA-CR-133768) Avail: NTIS HC \$3.00 CSCL 05B

N73-31297* Dartmouth Coll., Hanover, N.H. Dept. of Geography.

LAND USE IN NORTHERN MEGALOPOLIS Progress Report

Robert B. Simpson, Principal Investigator 10 Sep. 1973 2 p ERTS

(Contract NAS5-21749)

(E73-10991; NASA-CR-133770; PR-8) Avail: NTIS HC \$3.00 CSCL 08F

N73-31320* Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.

[OIL POLLUTION DETECTION AND MONITORING FROM SKYLAB EREP] Quarterly Progress Report, 1 Jun. - 31 Aug. 1973

Robert Horvath, Principal Investigator 19 Sep. 1973 2 p EREP

(Contract NAS9-13281)

(E73-11016; NASA-CR-133812; QPR-2) Avail: NTIS HC \$3.00 CSCL 08J

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N73-31322* Earth Satellite Corp., Washington, D.C.
SAMPLING STRATEGIES IN LAND USE MAPPING USING SKYLAB DATA Monthly Progress Report, Aug. 1973
 David S. Simonett, Principal Investigator Aug. 1973 5 p
 EREP
 (Contract NAS9-13314)
 (E73-11018; NASA-CR-133814; MPR-3) Avail: NTIS HC \$3.00 CSCL 08B

N73-31330* Geological Survey, Washington, D.C.
THE UTILIZATION OF ERTS-1 GENERATED PHOTOGRAPHS IN THE EVALUATION OF THE IRANIAN PLAYAS AS POTENTIAL LOCATIONS FOR ECONOMIC AND ENGINEERING DEVELOPMENT Progress Report, 1 Jul. - 31 Aug. 1973
 Daniel B. Krinsley, Principal Investigator 31 Aug. 1973 2 p
 ERTS
 (NASA Order S-70243-AG-3)
 (E73-11026; NASA-CR-133823) Avail: NTIS HC \$3.00 CSCL 08G

N73-31385* McDonnell Aircraft Co., St. Louis, Mo. Reconnaissance Lab.
AERIAL SURVEILLANCE SPILL PREVENTION SYSTEM
 C. L. Rudder, C. J. Reinheimer, and J. L. Berrey Aug. 1972 117 p
 (Contract EPA-88-01-0140)
 (PB-221484/8; EPA-R2-72-007; W73-11326) Avail: NTIS MF \$1.45; SOD HC \$3.00 as EPI.23/2:72-007 CSCL 13B
 An aerial surveillance system, was evaluated for the remote detection of both real and potential spills threatening inland waterways. Twenty-three multiband and baseline missions were flown over oil refineries and other industrial sites located adjacent to the Mississippi River. Baseline flights were effective in counting storage tanks, locating and identifying storage equipment and pipeline systems and determining dike conditions. Stereoscopic analysis of baseline imagery was used to estimate the height of tanks and dikes, drainage patterns and the area of openly stored waste products. The multiband imagery was obtained by combining each of nine filters with each of three different black and white films. Spectral contrast image enhancement was accomplished by either suppressing or transmitting the target reflected radiation through proper film/filter selections. Spills, effluents and waste areas were hence identified on the multiband imagery. Finally the personnel, equipment and procedures required to implement an aerial surveillance spill prevention system were determined. (Modified author abstract)
 GRA 0

N73-31395 Washington Univ., St. Louis, Mo.
THEORY AND APPLICATION OF REMOTE SENSORS IN AIR POLLUTION ENGINEERING Ph.D. Thesis
 Homer Wendell Hiser 1972 173 p
 Avail: Univ. Microfilms Order No. 73-11813

The basic principles of both active and passive remote sensors are presented, and signature concepts for identifying and measuring specific air pollution parameters are discussed. Radar systems are described and the equations are given for applying them. A radar is designed on the basis of these equations for detection and measurement of particulates. A method is presented for extracting thermal stability, humidity, and turbulence data in the lower atmosphere from temporal changes in radar reflections from stationary objects. Methods for estimating washout by precipitation and for measuring wind, turbulence, and temperature by direct and induced radar backscatter are outlined. Passive infrared, visible, and ultraviolet spectroscopic instruments for identifying and measuring gaseous pollutants also are described and evaluated.
 Dissert. Abstr.

N73-31581* National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
AIRBORNE MEASUREMENTS OF AIR POLLUTION CHEMISTRY AND TRANSPORT. 1: INITIAL SURVEY OF MAJOR AIR BASINS IN CALIFORNIA
 H. R. Gloria, J. N. Pitts, Jr., J. V. Behar, G. A. Bradburn, R. F.

Reinisch, and L. Zafonte 30 Sep. 1972 41 p refs Prepared in cooperation with Calif. Univ., Riverside
 (Grant NGR-05-008-029)
 (NASA-TM-X-69504; SAPRC-1) Avail: NTIS HC \$4.25 CSCL 13B

An instrumented aircraft has been used to study photochemical air pollution in the State of California. Simultaneous measurements of the most important chemical constituents (ozone, total oxidant, hydrocarbons, and nitrogen oxides, as well as several meteorological variables) were made. State-of-the-art measurement techniques and sampling procedures are discussed. Data from flights over the South Coast Air Basin, the San Francisco Bay Area, the San Joaquin Valley, the Santa Clara and Salinas Valleys, and the Pacific Ocean within 200 miles of the California coast are presented. Pollutants were found to be concentrated in distant layers up to at least 18,000 feet. In many of these layers, the pollutant concentrations were much higher than at ground level. These findings bring into serious question the validity of the present practice of depending solely on data from ground-based monitoring stations for predictive models. Author

N73-31584* Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Physik der Atmosphaere.
RESEARCH WORK OF THE DFVLR IN THE FIELD OF ENVIRONMENTAL PROTECTION. PART 1: AIR CLEANLINESS
 D. Paffrath 30 May 1972 93 p refs In GERMAN; ENGLISH summary
 (DLR-Mitt-72-14-Pt-1) Avail: NTIS HC \$6.75; DFVLR, Porz, West Ger. 23.80 DM

Topics in the field of air pollution and the remonitoring are dealt with. The emissions of air breathing engines were investigated, and measures are proposed to reduce these in, for example, the engine components, the fuels, and the combustion chambers. Possibilities of air pollution sensing from aircraft and satellite are reviewed. Problems of emissions in the atmosphere are discussed. The propagation of air pollutants through the atmosphere, as determined by meteorological and boundary layer parameters, is surveyed.
 ESRO

N73-31599* General Dynamics/Fort Worth, Tex. Convair Aerospace Div.
DESIGN AND CONSTRUCTION OF A SYSTEM FOR REMOTE OPTICAL SENSING OF EMISSIONS
 M. L. Streiff and C. L. Claysmith Oct. 1972 446 p
 (Contract EPA-CPA-22-69-142)
 (PB-221073/0; EPA-R2-72-052) Avail: NTIS HC \$6.00 CSCL 13B

The overall and detail instrument design and initial acceptance test performance of a system for remote sensing of emissions are described. The instrument may be used to measure transmission of urban atmospheres, using a remote source or to measure emission from sources such as smokestacks. It is designed to measure the absorption or emission caused by pollution by scanning spectrally in the 3 to 5.5 micron and 7 to 13.5 micron regions. Data may be recorded on a strip chart recorder, a digital printer, and/or a magnetic tape recorder. The various sections of the report provide: a discussion of the system design followed by a description of component details, setup procedures and operation, system performance in the laboratory and results of initial field tests, and maintenance recommendations.
 Author (GRA)

N73-32221* OVAAC 8 International, Inc., Columbia, Md
THE APPLICATION OF SATELLITE GENERATED DATA AND MULTISPECTRAL ANALYSIS TO REGIONAL PLANNING AND URBAN DEVELOPMENT
 Surendra Anant Raje and Gerald Willoughby, Principal Investigators 1 Oct. 1973 14 p Presented at NASA Symp., Sep. 1972 and Mar. 1973 and at GE Symp., Los Angeles, May 1973 Prepared for General Electric Co., Philadelphia, Pa. ERTS
 (Contract NAS5-21797)
 (E73-11045; NASA-CR-133930) Avail: NTIS HC \$3.00 CSCL 08F

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N73-32222*# Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.
AUTOMATIC PHOTOINTERPRETATION FOR LAND USE MANAGEMENT IN MINNESOTA Progress Report, Dec. 1972

George D. Swanlund, Principal Investigator and Raymond E. Zirkle
 Dec. 1972 2 p ERTS
 (Contract NAS5-21742)
 (E73-11046; NASA-CR-133944; PR-4) Avail: NTIS HC
 \$3.00 CSCL 08B

N73-32231*# Mississippi State Univ., State College. Dept. of Electrical Engineering.

STUDY OF THE APPLICATION OF REMOTE SENSING DATA TO LAND USE PLANNING ON THE MISSISSIPPI GULF COAST Progress Report, period ending 10 Oct. 1973

F. M. Ingels, Principal Investigator 5 Oct. 1973 2 p ERTS
 (Contract NAS5-21817)
 (E73-11055; NASA-CR-133945; PR-5) Avail: NTIS HC
 \$3.00 CSCL 08B

N73-32234*# Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.

AUTOMATIC PHOTOINTERPRETATION FOR LAND USE MANAGEMENT IN MINNESOTA Progress Report

George D. Swanlund, Principal Investigator, D. R. Pile, and Raymond E. Zirkle Feb. 1973 6 p ERTS

(Contract NAS5-21742)
 (E73-11058; NASA-CR-133948; PR-5) Avail: NTIS HC
 \$3.00 CSCL 08B

The author has identified the following significant results. Progress is being made in the areas of sun angle and atmospheric effects on the data and its interpretation. The effort is aimed at correction using only navigation and calendar data needed for satellite operation and derivations from the MSS data. Water estimation of value to land planners and conservationists has been demonstrated with verification of performance by comparison with a concurrent study involving map planimetry, aerial photos, and field-checking. The satellite will provide seasonal and annual coverage with timely information in a way not now feasible by conventional methods. For example, the reference data were obtained using the most recent files, which date back to 1949, and from most recent photography taken in 1968. The calendar time involved was three to four months, which is a reflection on priority pressure on trained manpower available. ERTS-1 data can help relieve this problem by providing the needed information while freeing trained manpower for more appropriate parts of the effort.

N73-32235*# Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.

AUTOMATIC PHOTOINTERPRETATION FOR LAND USE MANAGEMENT IN MINNESOTA Progress Report

George D. Swanlund, Principal Investigator and D. R. Pile Apr. 1973 15 p refs ERTS

(Contract NAS5-21742)
 (E73-11059; NASA-CR-133949; PR-6) Avail: NTIS HC
 \$3.00 CSCL 08B

The author has identified the following significant results. Primary conclusions from the lake acreage study are: (1) The ERTS-1 band 7 density range of 0-5 reliably indicates open water down to 2 acre size. (2) The density range 6-9 identifies swamps. (3) The depth of the water could not be determined. (4) Cloud shadows can be misread as lakes unless the clouds are detected. (5) ERTS-1 data would provide the information for classifying lakes and for monitoring fluctuations in lake area.

N73-32236*# Honeywell, Inc., Minneapolis, Minn. Systems and Research Div.

AUTOMATIC PHOTOINTERPRETATION FOR LAND USE MANAGEMENT IN MINNESOTA Progress Report

George D. Swanlund, Principal Investigator and Raymond E. Zirkle Jun. 1973 2 p ERTS

(Contract NAS5-21742)
 (E73-11060; NASA-CR-133951; PR-7) Avail: NTIS HC
 \$3.00 CSCL 08B

N73-32237*# Honeywell, Inc., Minneapolis, Minn. System and Research Div.

AUTOMATIC PHOTOINTERPRETATION FOR LAND USE MANAGEMENT IN MINNESOTA Progress Report

George D. Swanlund, Principal Investigator and D. R. Pile Aug. 1973 26 p ERTS

(Contract NAS5-21742)
 (E73-11061; NASA-CR-133950; PR-8) Avail: NTIS HC
 \$3.50 CSCL 08B

The author has identified the following significant results. The Minnesota Iron Range area was selected as one of the land use areas to be evaluated. Six classes were selected: (1) hardwood; (2) conifer; (3) water (including in mines); (4) mines, tailings and wet areas; (5) open area; and (6) urban. Initial classification results show a correct classification of 70.1 to 95.4% for the six classes. This is extremely good. It can be further improved since there were some incorrect classifications in the ground truth.

N73-32243*# Army Cold Regions Research and Engineering Lab., Hanover, N.H.

ARCTIC AND SUBARCTIC ENVIRONMENTAL ANALYSES UTILIZING ERTS-1 IMAGERY Bimonthly Progress Report, 23 Jun. - 23 Aug. 1973

Duwayne M. Anderson, Principal Investigator, H. L. McKim, R. K. Haugen, L. W. Gatto, C. W. Slaughter, and T. Marlar 23 Aug. 1973 5 p refs ERTS

(NASA Order S-70253-AG)
 (E73-11067; NASA-CR-135523; BMPR-5) Avail: NTIS HC
 \$3.00 CSCL 08E

N73-32269*# Minnesota Univ., Minneapolis. Dept. of Environmental Health.

FEASIBILITY OF DETECTING MAJOR AIR POLLUTANTS BY EARTH ORIENTED SATELLITE-BORNE SENSORS

Harold J. Paulus and David W. Hoffman *In its A Study of* Minn. Forests and Lakes using Data from ERTS 30 Jun. 1973 p 77

CSCL 04B

An attempt was made to use ERTS-1 MSS imagery to aid in evaluating air pollution around the Minnesota area. Data are correlated with local measurements. Injuries to forest and crop vegetation were also evaluated.

E.H.W.

N73-32282*# Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.

REMOTE SENSING IN MICHIGAN FOR LAND RESOURCE MANAGEMENT Annual Report, 1 Jun. 1972 - 1 Jun. 1973

I. J. Sattinger, A. N. Sellman, L. B. Istvan, and J. J. Cook Jul. 1973 62 p refs

Original contains color illustrations
 (Grant NGR-23-005-552)
 (NASA-CR-135639; ERIM-193400-2-F) Avail: NTIS HC
 \$5.25 CSCL 08F

During the period from June 1972 to June 1973, remote sensing techniques were applied to the following tasks: (1) mapping Michigan's land resources, (2) waterfowl habitat management at Point Mouillee, (3) mapping of Lake Erie shoreline flooding, (4) highway impact assessment, (5) applications of the Earth Resources Technology Satellite, ERTS-1, (6) investigation of natural gas eruptions near Williamsburg, and (7) commercial site selection. The goal of the program was the large scale adaption, by both public agencies and private interests in Michigan, of earth-resource survey technology as an important aid in the solution of current problems in resources management and environmental protection.

Author

N73-32501# Esso Research and Engineering Co., Linden, N.J. Government Research Lab.

A WORKING DOCUMENT FOR AIR POLLUTION MEASUREMENT TECHNIQUE DEVELOPMENT: FISCAL YEARS 1972-1977

Dec. 1971 218 p
 (Contract CPA-22-69-154)
 (PB-221011; APTD-1451; GRU.2GAPI.71) Avail: NTIS CSCL
 13B

02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

A research, development, test and evaluation plan for the environmental Protection Agency, covering the fiscal years 1972 through 1977 is presented. The plan will provide for development of air pollution measurement techniques; to support EPA research and investigations into the causes, effects, and extent of air pollution; to identify and quantify air pollutants; to assist in the setting of standards and to determine compliance with standards; and to support a continuing EPA effort to maintain adequate measurement capabilities. GRA

N73-32846*# Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.

A STUDY OF THE POTENTIAL OF REMOTE SENSORS IN URBAN TRANSPORTATION PLANNING

Dietmar Rietschier and David G. Modlin, Jr. Jun. 1973 172 p refs

(Contract NAS8-29012)

(NASA-CR-124433) Avail: NTIS HC \$10.75 CSCL 05A

The potential uses of remotely sensed data as applied to the transportation planning process are presented. By utilizing the remote sensing technology developed by the National Aeronautics and Space Administration in the various space programs, it is hoped that both the expense and errors inherent in the conventional data collection techniques can be avoided. Additional bonuses derived from the use of remotely sensed data are those of the permanent record nature of the data and the traffic engineering data simultaneously made available. The major mathematical modeling phases and the role remotely sensed data might play in replacing conventionally collected data are discussed. Typical surveys undertaken in the overall planning process determine the nature and extent of travel desires, land uses, transportation facilities and socio-economic characteristics. Except for the socio-economic data, data collected in the other surveys mentioned can be taken from photographs in sufficient detail to be useful in the modeling procedures. Author

N73-33246*# Brevard County Planning Dept., Titusville, Fla. **PLANNING APPLICATIONS IN EAST CENTRAL FLORIDA** Progress Report, 1 Feb. - 31 Sep. 1973

John W. Hannah, Garland L. Thomas, and Fernando Esparza, Principal Investigators 30 Sep. 1973 38 p ref ERTS

(Contract NAS5-21847)

(E73-11083; NASA-CR-135551) Avail: NTIS HC \$4.00 CSCL 08B

N73-33252*# Ohio Dept. of Economic and Community Development, Columbus.

[REGIONAL AND LOCAL LAND USE PLANNING AND MAPPING FROM SKYLAB DATA] Quarterly Progress Report, Jul. - Sep. 1973

David C. Sweet, Principal Investigator 5 Oct. 1973 2 p EREP

(NASA Order C-21372-C)

(E73-11090; NASA-CR-135558) Avail: NTIS HC \$3.00 CSCL 08F

N73-33255*# Geological Survey, Washington, D.C.

LAND USE MAPPING AND MODELLING FOR THE PHOENIX QUADRANGLE Progress Report, 1 Jul. - 31 Aug. 1973

John L. Place, Principal Investigator 1 Sep. 1973 4 p ERTS

(NASA Order S-70243-AG)

(E73-11098; NASA-CR-135567) Avail: NTIS HC \$3.00 CSCL 08B

N73-33266*# Pennsylvania State Univ., University Park. Space Science and Engineering Lab.

LAND USE MAPPING Interim Report

George J. McMurtry, Gary W. Petersen, Principal Investigators, F. Y. Borden, H. A. Weeden, D. N. Applegate, and N. B. Bolling May 1973 10 p ref Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-23133)

(E73-11109; NASA-CR-135578; ORSER-SSEL-TR-14-73) Avail: NTIS HC \$3.00 CSCL 08B

N73-33269*# Pennsylvania State Univ., University Park. Space Science and Engineering Lab.

ACID MINE DRAINAGE AND STRIP MINES Interim Report

George J. McMurtry, Gary W. Petersen, Principal Investigators, S. S. Alexander, and J. L. Dein May 1973 8 p ref ERTS (Contract NAS5-23133)

(E73-11112; NASA-CR-135581; ORSER-SSEL-TR-23-73) Avail: NTIS HC \$3.00 CSCL 08I

N73-33270*# Cornell Univ., Ithaca, N.Y. Dept. of Natural Resources.

EVALUATION OF SATELLITE IMAGERY AS AN INFORMATION SERVICE FOR INVESTIGATING LAND USE AND NATURAL RESOURCES (SKYLAB) Progress Report, 1-30 Sep. 1973

Ernest E. Hardy, Principal Investigator 30 Sep. 1973 1 p EREP

(Contract NAS9-13364)

(E73-11113; NASA-CR-135582) Avail: NTIS HC \$3.00 CSCL 08B

N73-33271*# Pennsylvania State Univ., University Park. Office for Remote Sensing of Earth Resources.

INTERDISCIPLINARY APPLICATION AND INTERPRETATION OF ERTS DATA WITHIN THE SUSQUEHANNA RIVER BASIN (RESOURCE INVENTORY, LAND USE, AND POLLUTION): PROGRAM DESCRIPTIONS Interim Report

George J. McMurtry, Gary W. Petersen, Principal Investigators, F. Y. Borden, D. N. Applegate, B. J. Turner, H. M. Lachowski, and J. R. Hoosty May 1973 92 p refs ERTS

(Contract NAS5-23133)

(E73-11114; NASA-CR-135583; ORSER-SSEL-TR-10-73) Avail: NTIS HC \$6.75 CSCL 08H

N73-33272*# Pennsylvania State Univ., University Park. Space Science and Engineering Lab.

CATALOGUES FOR REMOTE SENSING DIGITAL DATA TAPES Interim Report

George J. McMurtry, Gary W. Petersen, Principal Investigators, F. Y. Borden, H. M. Lachowski, and D. N. Applegate May 1973 22 p ERTS

(Contract NAS5-23133)

(E73-11115; NASA-CR-135584; ORSER-SSEL-TR-18-73) Avail: NTIS HC \$3.25 CSCL 05B

N73-33279*# Corps of Engineers, Champaign, Ill.

EFFECTS OF CONSTRUCTION AND STAGED FILLING OF RESERVOIRS ON THE ENVIRONMENT AND ECOLOGY Progress Report, 9 Aug. - 8 Oct. 1973

Ravinder K. Jain, Principal Investigator 8 Oct. 1973 2 p ERTS

(NASA Order S-70255-AG)

(E73-11124; NASA-CR-135662) Avail: NTIS HC \$3.00

N73-33298*# Mitre Corp., McLean, Va.

INVESTIGATION OF ENVIRONMENTAL INDICES FROM THE EARTH RESOURCES TECHNOLOGY SATELLITE Interim Report, Mar. - Aug. 1973

E. A. Ward, Principal Investigator, E. L. Riley, and S. Stryker Aug. 1973 129 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21842)

(E73-11143; NASA-CR-135702; M73-206; IR-2) Avail: NTIS HC \$8.50 CSCL 05B

02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

N73-33304*# Environmental Research Inst. of Michigan, Ann Arbor.

STUDY OF RECREATIONAL LAND AND OPEN SPACE USING SKYLAB IMAGERY Monthly Progress Report, Sep. 1973

Irvin J. Sattinger, Principal Investigator 10 Oct. 1973 4 p EREP

(Contract NAS9-13283)

(E73-11150; NASA-CR-135738; ERIM-103300-11-L) Avail: NTIS HC \$3.00 CSCL 08B

N73-33310*# Pennsylvania State Univ., University Park. Office for Remote Sensing of Earth Resources.

INTERDISCIPLINARY APPLICATIONS AND INTERPRETATIONS OF ERTS DATA WITHIN THE SUSQUEHANNA RIVER BASIN: RESOURCE INVENTORY, LAND USE, AND POLLUTION Progress Report, 1 Jun. - 30 Nov. 1972

G. J. McMurtry and G. W. Petersen, Principal Investigators Dec. 1972 31 p refs ERTS

(Contract NAS5-23133)

(E73-11156; NASA-CR-135744) Avail: NTIS HC \$3.75 CSCL 09B

03

GEODESY AND CARTOGRAPHY

Includes mapping and topography.

A70-15770

THERMAL MAPPING.

Richard Blythe and Ellen Kurath (Bendix Corp., Aerospace Systems Div., Ann Arbor, Mich.).

SPIE Journal, vol. 8, Nov. 1969, p. 18-23.

Discussion of the usefulness of thermal mapping for civilian applications. Some of the functions that can be performed by IR imagery are discussed, and physical principles affecting the appearance of the results are briefly considered. Examples are given to show the capability of thermal mapping for analyzing quite different phenomena—namely, fire, water, and soil conditions. A line-scanning IR imagery system, used to obtain the imagery samples discussed, is described. G.R.

A70-16685

MAPPING THE EARTH WITH ELASTIC WAVE HOLOGRAPHY.

Daniel Silverman (Pan American Petroleum Corp., Tulsa, Okla.).

(*Institute of Electrical and Electronics Engineers, Annual International Geoscience Electronics Symposium, 1st, Washington, D.C., Apr. 16-18, 1969.*)

IEEE Transactions on Geoscience Electronics, vol. GE-7, Oct. 1969, p. 190-199, 26 refs.

Discussion of the application of the basic principles of optical wavefront reconstruction to sonic and seismic wave holography. The problems of scaling and field sampling are considered, showing that the sampling density required for the adequate resolution of elastic wave systems is within the practical field limits. Experiments are carried out with a small water tank model using frequencies in the low megahertz range and small metal objects. The resulting holograms and photographs of the reconstructed object images are included. The problems of recording and displaying the results are discussed. V.Z.

A70-18941

NICE-BEIRUT LINK WITH THE HELP OF OBSERVATIONS FROM THE D1A SATELLITE (DIAPASON) (LIAISON NICE-BEYROUT A L'AIDE DES OBSERVATIONS DU SATELLITE D1A /DIAPASON/).

J. Kovalevsky (Bureau des Longitudes, Paris, France), F. Bartier (Meudon, Observatoire, Meudon, Hauts-de-Seine, France), and I. Stellmacher (Paris, Université, Faculté des Sciences, Paris, France).

(*Association Internationale de Géodésie, Symposium Commun des Commissions de la Nouvelle Compensation de la Triangulation Européenne et du Réseau Européen sur Satellites Artificiels, Paris, France, Feb. 24-Mar. 1, 1969.*)

Bulletin Géodésique, Sept. 1, 1969, p. 235-242, 6 refs. In French.

Reduction of data from the D1A satellite, which transmitted signals on frequencies of 400 and 150 MHz to ground stations at Nice and Beirut. The purpose was to study all the problems related to the application of Doppler measurements to geodesy and, definitively, to attempt a geodetic link between Nice and Beirut. The greatest difficulties encountered were due to the problems posed by sorting the observations, and the length of the observed arc. The method of treatment applied is explained, keeping in view that the aim of these treatments is to select those observations which bring the maximum information on the relative position of the stations. F.R.L.

A70-22878 * # Digital computer terrain mapping from multispectral data, and evaluation of proposed Earth Resources Technology Satellite (ERTS) data channels, Yellowstone National Park—Preliminary report. Harry W. Smedes, Kenneth L. Pierce (U.S. Geological Survey, Denver, Colo.), Marc G. Tanguay (Montréal, Université, Montréal, Canada), and Roger M. Hoffer (Purdue University, West Lafayette, Ind.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-309*. 19 p. 6 refs. Members, \$1.00; nonmembers, \$1.50. NASA Contract No. R-09-020-015.

Brief description of the preliminary results and current status of studies of digital computer processing of airborne multispectral data, the success of automatic recognition and mapping of the distribution of eight different terrain types, and the effectiveness of the proposed Earth Resources Technology Satellite (ERTS) data channels as compared to the computer-selected best four channels in the automatic recognition and mapping of the same terrain types based on simulations, using the same set of data. This study involves the data from one flight over a test area of about 12 square miles in a region of moderate relief comprising a wide variety of terrain types. The data were acquired and processed in analog form and were then processed in digital form. Only the preliminary study of the digital processing is treated. The following terrain types have been mapped with greater than 80 percent accuracy: bedrock exposures, talus, vegetated rock rubble, glacial kame terrace, glacial till, forest, bog, and water. Shadows of clouds and cliffs are depicted. Simulations resulted in maps whose accuracies were only a few percent less than that using the best set of four channels; they indicate that the ERTS data channels are likely to be successful for terrain analysis of a wide variety of categories encompassing a broad range of spectral reflectance. These studies also indicate that, for a broad range of terrain categories, many combinations of 3 or 4 channels of data would be satisfactory. M.M.

A70-24642

The contribution of satellite geodesy to the determination of the figure and the internal constitution of the earth. Erwin Groten (München, Technische Hochschule, Munich, West Germany). (*British Interplanetary Society and NATO, International Summer School on Earth Resources Survey Satellites, Gonville and Caius College, Cambridge, England, July 14-25, 1969.*) *British Interplanetary Society, Journal*, vol. 23, Apr. 1970, p. 325-328.

Review of recent, present, and expected future contributions of satellite geodesy to knowledge about the earth. In particular, the gains derived from these contributions for the precise mapping of the earth's surface, as well as for the determination of the shape and internal constitution of the earth, are reviewed. M.V.E.

A70-24726

American Society of Photogrammetry, Annual Meeting, 36th, Washington, D.C., March 1-6, 1970, Technical Papers. F. H. Church, Va., American Society of Photogrammetry, 1970. 778 p. \$10.00.

Contents:

Geometric fidelity of three space television systems. K. W. Wong (Illinois, University, Urbana, Ill.), p. 1-22.

Theoretical study of map compilation from NASA satellite photographs. R. J. Karren (U.S. Geological Survey, McLean, Va.), p. 23-58, 7 refs.

Testing of the convergence conditions in analytical aerial triangulation. V. Krátký (National Research Council, Ottawa, Canada), p. 59-77.

Computer simulation of automatic stereoplotters. A. E. Whiteside and D. B. Lipski (Bendix Corp., Southfield, Mich.), p. 78-92.

Analytical MUSAT evaluation of AN/USQ-28 SHIRAN-controlled aerial photography. J. E. Unverferth, II (U.S. Army, Engineer Topographic Laboratories, Fort Belvoir, Va.), p. 93-110.

03 GEODESY AND CARTOGRAPHY

A study in Independent Model Aerotriangulation. P. R. Wolf (California, University, Berkeley, Calif.), p. 111-122. 9 refs.

Lunar control development. K. O. Whitfield (Aeronautical Chart and Information Center, St. Louis, Mo.), p. 123-170. 9 refs.

Computer techniques for remote sensing. P. D. Fligor, p. 171-186.

ADP of aerial imagery for forest discrimination. L. A. LeSchack (Development and Resources Transportation Co., Silver Spring, Md.), p. 187-218. 6 refs.

Automated processing for earth resources. L. E. Mumbower (IBM Corp., Gaithersburg, Md.), p. 219.

Determination of the shape of thin soap membranes by means of photogrammetry. W. Faig (Illinois, University, Urbana, Ill.), p. 220-246. 27 refs.

Photogrammetry as a tool of experimental structural mechanics. R. H. Brock (New York, State University, Syracuse, N.Y.), B. A. Wasil (Syracuse University, Syracuse, N.Y.), and L. U. Bender (Ohio State University, Columbus, Ohio), p. 247, 248.

On 'The Book of Nature Is Written in Characters of Geometry'—Galileo. R. E. Herron (Baylor University, Houston, Tex.), p. 249-255.

Stereophotogrammetry in human motion analysis. M. M. Ayoub and M. A. Ayoub (Texas Technological University, Lubbock, Tex.), p. 256-288.

Characteristics of architectural photogrammetry. P. E. Borchers (Ohio State University, Columbus, Ohio), p. 289-305.

Rationalized surveying—Photogrammetry used in Austrian monument protection. H. Foramitti (Bundesdenkmalamt, Vienna, Austria), p. 306-334.

Contouring scanning electron stereo photomicrographs. T. P. Rooney (USAF, Cambridge Research Laboratories, Bedford, Mass.), J. R. Aronson (Arthur D. Little, Inc., Cambridge, Mass.), and K. Heinemann (Aeronautical Chart and Information Center, St. Louis, Mo.), p. 335-337.

Remote sensing in land resource inventory in the urban fringe area. H. W. Dill, Jr. (U.S. Department of Agriculture, Washington, D.C.), p. 338-342.

Summary of inter-census population estimation by the use of air photos and U.S.G.S. topographic maps—A sample study of population change in the Atlanta area. S. Hsu (Georgia, University, Athens, Ga.), p. 343-350.

Cornell aerial photo inventories of urban land use and natural resources. J. T. Roach (Cornell University, Ithaca, N.Y.), p. 351-362.

Remote sensing of urban environments in southern California. L. W. Bowden (California, University, Riverside, Calif.), p. 363-373.

Orthophoto Attachment for the wild A8 autograph. G. E. Bormann (Wild Heerbrugg AG, Heerbrugg, Switzerland), p. 374-388.

Analog stereophotogrammetric instrumentation restitution accuracy. A. M. Aguilar (Kansas State University of Agriculture and Applied Science, Manhattan, Kan.), p. 389-404.

Remote detection of oil pollution within the 8-14 micron infrared region. P. B. Chandler (North American Rockwell Corp., Downey, Calif.), p. 405-421. 10 refs.

Determination of water depth by remote measurement of reflectance of underwater plants in the near-infrared. D. L. Spooner and L. R. Lankes (Lockheed Electronics Co., Houston, Tex.), p. 422-434.

Geologic mapping applications of coastal aerial photography, Cape Cod, Massachusetts. R. S. Williams, Jr. (USAF, Cambridge Research Laboratories, Bedford, Mass.) and J. D. Friedman (U.S. Geological Survey, Washington, D.C.), p. 435, 436.

Applications of multispectral data collection and processing techniques applied to hydrobiological investigations in Everglades National Park, Florida. A. L. Higer, M. C. Kolipinski (U.S. Geological Survey, Miami, Fla.), N. S. Thomson, and F. J. Thomson (Michigan, University, Ann Arbor, Mich.), p. 437-470.

Airborne use of the AGA Thermovision real time infrared scanner. C. Warren (Michigan, University, Ann Arbor, Mich.), p. 471-483.

Some preliminary thoughts on remote sensing and rights of privacy. R. P. Latham, p. 484-495. 17 refs.

Comparison of multibase and multiemulsion photography for identifying crop and soil conditions from space. C. L. Wiegand, R. W. Leamer, D. A. Weber, and A. H. Gerbermann (U.S. Department of Agriculture, Weslaco, Tex.), p. 496-511. 7 refs.

Aerial photograph use in timber management programs in the South. R. D. Baker (Stephen F. Austin State University, Nacogdoches, Tex.), p. 512-520.

Space photographs in forest inventories. R. C. Aldrich (U.S. Forest Service, Berkeley, Calif.), p. 521-523.

Evaluation of SLR imagery for interpretation of tropical lowland vegetation. G. E. Howard and C. D. Sapp (Raytheon Co., Alexandria, Va.), p. 524-532. 8 refs.

An aerial photographic survey of coastal erosion. D. B. Stafford (Clemson University, Clemson, S.C.) and J. Langfelder (North Carolina State University, Raleigh, N.C.), p. 533-558. 15 refs.

Airphoto analysis of ocean outfall dispersion. W. James and F. J. Burgess (Oregon State University, Corvallis, Ore.), p. 559-582.

Discharge properties of drainage basins observable from aerial photographs. S. I. Majtenyi (Tippett-Abbott-McCarthy-Stratton, New York, N.Y.) and D. J. Belcher (Cornell University, Ithaca, N.Y.), p. 583-595. 8 refs.

Critical terrain analysis. G. T. Hunter (Airphoto Analysis Associates, Toronto, Canada) and S. J. G. Bird (Toronto, University, Toronto, Canada), p. 596-636. 13 refs.

Aerial ground resolution estimations for the image interpreter. C. Haakon (Raytheon Co., Alexandria, Va.), p. 637.

Automatic radar change detection. A. Blache, R. F. Bunn (Raytheon Co., Alexandria, Va.), and J. Horn (USAF, Rome Air Development Center, Griffiss AFB, N.Y.), p. 638, 639.

Subjective considerations for stereo radar. G. L. LaPrade (Goodyear Aerospace Corp., Litchfield Park, Ariz.), p. 640-651.

Automated contouring from photogrammetric profile data. M. B. Strain (U.S. Geological Survey, Denver, Colo.), p. 652-661.

Photogrammetric analysis of non-synchronous pair of U.F.O. exposures. E. L. Merritt (Raytheon Co., Alexandria, Va.), p. 662-669.

Current status of orthophotomapping in the USGS. R. R. Mullen (U.S. Geological Survey, McLean, Va.), p. 670-676.

Experiences in orthophoto mapping with the S.F.O.M. orthophotoscope. J. S. Simpson and J. B. Turner (Survair, Ltd., Ottawa, Canada), p. 677-685.

Orthophotographs in cadastral surveys. M. C. van Wijk (National Research Council, Ottawa, Canada), p. 686-699.

Urban cadaster of the city of Chihuahua. G. L. Gordillo and R. B. Eguarte (Cia. Mexicana Aerofoto, S. A., Mexico City, Mexico), p. 700-721.

A method for improving tree measurements from large-scale 70 mm photographs. S. Cunningham (New York, State University, Syracuse, N.Y.), p. 722-728.

Determination of concentration of polluted air by photogrammetry. S. A. Veress (Washington, University, Seattle, Wash.), p. 729-749. 19 refs.

Mapping with super-wide angle photography—Some observations on the cost advantage, the accuracy, and the photographic problem. J. R. R. Gauthier (Department of Energy, Ottawa, Canada), p. 750-769. 13 refs.

A70-24751 Critical terrain analysis. Garry T. Hunter (Airphoto Analysis Associates, Toronto, Canada) and S. J. Glenn Bird (Toronto, University, Toronto, Canada). In: American Society

of Photogrammetry, Annual Meeting, 36th, Washington, D.C., March 1-6, 1970, Technical Papers. Falls Church, Va., American Society of Photogrammetry, 1970, p. 596-636. 13 refs.

Qualitative analysis of the physical factors which affect the final recorded image in terrain analysis by color and color IR aerial photography. Attention is given to the solar spectrum, films, filters, processing, camera lens, focusing, exposure, and terrain characteristics; the selection of proper color balance for both color and color IR photography is also considered. The earth's surface is treated under five basic categories of vegetation, exposed soils and rocks, water, snow and ice, and urban areas. The variables, including reflectance characteristics, are examined in detail and illustrated by color photographic examples. Typical characteristics and spectral sensitivity curves of photographic films are plotted, and recommendations are given for specific types of terrain. T.M.

A70-25047 Roughness of simulated planetary terrain. G. A. McCue (North American Rockwell Corp., Space Div., Downey, Calif.) and J. Green (Douglas Advanced Research Laboratories, Huntington Beach, Calif.). *Photogrammetric Engineering*, vol. 36, Mar. 1970, p. 273-279. 11 refs.

Four areas closely representing hypothetical extremes of extra-terrestrial terrain relief and roughness were chosen from volcanic terrain adjoining Pissgah Crater, California. The areas were surveyed and mapped using high precision photogrammetric methods. A contour interval of 25 centimeters was utilized to preserve details in each of the square areas which measure 305 meters (1000 feet) on a side. Terrain data were digitized for computer utilization by recording surface elevations at one-meter intervals throughout each area. A digital computer contouring technique was employed to generate contour maps from the digitized terrain data, thus confirming the validity of the numerical data. A numerical terrain traverse simulation then was performed by randomly positioning a three-wheeled vehicle upon the hypothesized terrain. One the vehicle was in place it was possible to note if it could successfully traverse by computing the deviation from vertical of the vehicle axes. By computing over 50,000 random positions it was possible to develop statistics from which the probability of successful traverse may be inferred as a function of terrain type, wheel radius, coefficient of friction, and leg radius. The orientation of the plane of the triangular base provided an interesting statistical measure of the roughness characteristics of the terrain. (Author)

A70-26190 # Satellite triangulation data reduction methods at the U.S. Coast and Geodetic Survey. Ch. Theurer (U.S. Coast and Geodetic Survey, Rockville, Md.). In: *Reduction of satellite photographic plates; COSPAR, Colloquium, Prague, Czechoslovakia, April 22-27, 1968, Proceedings.* Edited by Jean Kovalevsky and George Veis. Paris, COSPAR Secretariat (COSPAR Transactions, No. 7), 1970, p. 129-135; Discussion and Comments, H. M. Dufour (Institut Géographique National, Paris, France), M. Schürer (Astronomical Institute, Berne, Switzerland), and H. Debehogne (Observatoire Royal de Belgique, Brussels, Belgium); p. 136.

An interconnected world geodetic datum has been made possible by geometric satellite geodesy. The data acquisition system used by the U.S. Coast and Geodetic Survey is briefly described. Plate preparation, measurement and data reduction phases is discussed in more detail. A summary of accuracies achieved is given in conclusion. (Author)

A70-26191 # General plan for spatial geodesy calculations based on photographs of satellites against a star background (Plan général des calculs de géodésie spatiale à partir des photographies de satellites sur fond d'étoiles). H. M. Dufour (Institut Géographique National, Paris, France). In: *Reduction of satellite photographic plates; COSPAR, Colloquium, Prague, Czechoslovakia, April 22-27, 1968, Proceedings.* Edited by Jean Kovalevsky

and George Veis. Paris, COSPAR Secretariat (COSPAR Transactions, No. 7), 1970, p. 137-163. 8 refs. In French.

The author describes the method still in use at the Institut Géographique National of France for the determination in space of the position of light flashes when the terrestrial coordinates of observing stations are known. He indicates what modifications should be introduced for the observation of ECHO type satellites for geodetic use. He also suggests improvements that can be applied to the method in order to achieve the maximum from the existing information on each photographic plate. (Author)

A70-26913 # Slope failure forms - Their identification, characteristics, and distribution as depicted by selected remote sensor returns. Donald H. Poole (East Tennessee State University, Johnson City, Tenn.). In: *International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings, Volume 2.* Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 927-965. 94 refs.

Discussion of criteria for recognizing slope failure forms on the basis of aerial photographs taking into consideration an application of these criteria to the mapping of slope failure phenomena. Results of the study indicate that the mapping of slope failure forms can be achieved relatively easily and rapidly providing suitable aerial photographs are available. Small scale photography most suitable for general slope failure studies should be at a scale of 1/20,000 to ensure recognition and positive identification of erosional and mass wastage forms. Large scale photography at a scale of 1/10,000 or larger, would be appropriate and conducive to microstudies of slope failure phenomena. Either Ektachrome or Ektachrome infrared imagery would produce good results provided the photography was of high quality. G.R.

A70-26914 * # Geopedological features derived from satellite measurements in the 3.4-4.2 micron and 0.7-1.3 micron spectral regions. J. Pouquet (NASA, Goddard Space Flight Center, Greenbelt, Md.). In: *International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings, Volume 2.* Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 967-983. 3 refs.

Discussion of the use of satellite measurements for the derivation of geopedological features taking into account Nimbus 2 data and a few Nimbus 2 grid print maps. The technical aspects are examined. The data received from the spacecraft are processed in order to get photo facsimile and computer produced grid print maps. The grid print maps are the medium allowing accurate research within the field of geomorphology-geopedology. The thermal nighttime values are related to the heat capacity of the rocks, soils, vegetation, and to the alimetric position. When thermal values are not explained by a higher or lower elevation, one finds a clue for the remote detection of wet areas, ancient valleys, soil moisture, for the recognition of tectonic accidents, for the discrimination of weathered sands vs fresh ones, and for the survey of eroded soils. G.R.

A70-27237 Landscape structure in aerial photos (Das landschaftliche Gefüge im Luftbild). Heinz Fischer (Bundesforschungsanstalt für Landeskunde und Raumordnung, Bad Godesberg, West Germany). *Naturwissenschaftliche Rundschau*, vol. 23, Apr. 1970, p. 143-151. 18 refs. In German.

Discussion of the feasibility of interpreting structural features of landscapes from aerial photos taken vertically from overflying aircraft. A distinction is made between direct interpretation, a straightforward process, and indirect interpretation, in which conclusions are reached on the basis of certain natural relations between

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various landscape elements. Two examples are analyzed in detail to show what conclusions can be drawn from an individual aerial photo in cases where special instrument aids to evaluation are not available or cannot be used. The proposed method is recommended for use when only an individual photo is available and not the usual series of pictures with the overlapping required for stereoscopic evaluation.

A.B.K.

A70-29207 # Best-fitting tri-axial earth ellipsoid parameters derived from satellite observations. Milan Burša (Výzkumný Ústav Geodézie, Prague, Czechoslovakia). *Studia Geophysica et Geodaetica*, vol. 14, no. 1, 1970, p. 1-9. 10 refs.

Calculation of best fitting parameters of the tri-axial earth ellipsoid representing the geoidal surface. The expression for the radius-vector of the geoidal surface by means of spherical harmonics with coefficients, computed from satellite observations, is presented. A series of spherical harmonics is also used to express the radius-vector of the tri-axial ellipsoid, and four parameters of the Earth's body are derived. In addition, a numerical solution is carried out, and the results are tabulated.

O.H.

A70-29208 # Geopotential and gravity on external surfaces as derived from satellite observations. Milan Burša (Výzkumný Ústav Geodézie, Prague, Czechoslovakia). *Studia Geophysica et Geodaetica*, vol. 14, no. 1, 1970, p. 10-24. 19 refs.

A set of harmonic coefficients derived from satellite orbit dynamics defines (together with the geocentric constant and the spin angular velocity) the geopotential, gravity, and its derivatives in outer space. These quantities may be determined on arbitrary external surfaces surrounding the earth, provided their equations are known in the geocentric system. This is carried out for triaxial external ellipsoids as well as for equipotential surfaces, and the results are applied to deriving the fundamental shape parameters of the earth's body.

(Author)

A70-29529 # Determination of the relative positions of two geodetic systems from synchronous observations of artificial earth satellites (Bestimmung der Wechsellage zweier geodätischer Systeme aus Synchronbeobachtungen von künstlichen Erdsatelliten). Weneda Dobaczewska (Polska Akademia Nauk, Instytut Geofizyki, Warsaw, Poland). *Artificial Satellites*, vol. 4, June 1968, p. 10-15. In German.

Discussion of a procedure for interrelating two geodetic systems by referring them to a common coordinate system on the basis of synchronous artificial earth satellite observations. Procedures are described for determining the inclination of the axis of one of the two reference ellipsoids with respect to the axis of the other reference ellipsoid, the relative positions of the centers of these ellipsoids and the scale ratio of these ellipsoids.

V.Z.

A70-31548 Representation of the earth's gravitational field in satellite geodesy by means of the potential of a simple layer (Darstellung des Erdschwerefeldes in der Satellitengeodäsie durch das Potential einer einfachen Schicht). Karl-Rudolf Koch. *Zeitschrift für Vermessungswesen*, vol. 95, May 1970, p. 173-179. 23 refs. In German.

The representation of the gravity field of the earth by means of the potential of a simple layer is described. This representation is compared with the expansion of the geopotential in spherical harmonics, generally used in satellite geodesy, and with the model of the gravity field using Stokes' function and the model applying buried masses. The flexibility of the representation using the potential of a simple layer is shown with respect to the analysis of future satellite altimeter measurements and with respect to the processing of photogrammetric data obtained from satellites.

(Author)

A70-33525 The laser geodimeter of the Coast and Geodetic Survey (Das laser-Geodimeter des Coast and Geodetic Survey). Harald W. Straub, Josef M. Arthaber, and Augustine L.

Copeland (U.S. Coast and Geodetic Survey, Rockville, Md.). *Mess-technik*, vol. 78, May 1970, p. 106, 107. In German.

To perform length measurements more economically on its continental traverses, Coast and Geodetic Survey Laboratory personnel replaced the mercury arc lamp in the AGA Model 4 D Geodimeter with a helium-neon laser. The paper also describes the additional alterations necessitated by that change, enabling distances of more than 80 km to be measured in one step to the same accuracy of 1 in a million as before the alteration. The red laser light's high haze-penetration capability also enabled long-range measurements to be made under such conditions that neither the distant cube-corner reflector unit nor the return beam were visible from the station.

(Author)

A70-37408 # Aerial-photo plotting of aerogeophysical routes and anomalies (Fotopriviazka aerogeofizicheskikh marshrutov i anomalii) (2nd revised and enlarged edition). I. D. Boshniakovich and Iu. S. Glebovskii. Leningrad, Izdatel'stvo Nedra, 1969. 209 p. 16 refs.

This monograph discusses the aerial-photo plotting techniques designed and developed by research and industrial agencies of the USSR Ministry of Geology for aerial strip photography. The equipment, procedures, and materials used by these techniques are described. Their theoretical foundations are also considered, with special attention to the positive and negative characteristics of photo-plotting procedures. Special cases of application, such as in detailed surveys at altitudes below 100 m and in the presence of geophysical anomalies, are covered. Various aspects of the organization, planning and execution of aerial surveys are also considered. The monograph is addressed to specialists in the field of aerial photography.

V.Z.

A70-39061 User needs in geology and cartography. William A. Fischer (U.S. Geological Survey, Washington, D.C.). In: Princeton University, Conference on Aerospace Methods for Revealing and Evaluating Earth's Resources, Princeton University, Princeton, N.J., September 25, 26, 1969, Proceedings.

Edited by J. P. Layton. Princeton, N.J., Princeton University Conference, 1970, p. 11.1-11.7, 11.9-11.22; Discussion, 11.23, 11.24.

Discussion of the data needs of geology and cartography taking also into consideration the technological developments that are needed to acquire and process the data. Aerial photographs of the surface of the earth obtained by aircraft and by satellite are considered. Repetitive coverage of a planimetric nature from space is recommended, and the continuance of the programs of topographic mapping from aircraft at regular but infrequent intervals is suggested. The usefulness of space photos as maps is discussed, and aspects of geological exploration are investigated taking into account the mapping of snow and vegetation and the study of the thermal structure of the earth.

G.R.

A70-41268 Design and performance of modern aerial cameras (Aufbau und Leistungsfähigkeit neuzeitlicher Luftbildkameras). Hans-Karsten Meier (Carl Zeiss, Oberkochen, West Germany). *VDI-Z*, vol. 112, no. 16, 1970, p. 1079-1084. 10 refs. In German.

Discussion of the present state of development of aerial cameras used for topographic mapping. Following a brief review of the objectives of aerial photography and its history, the design of aerial cameras is considered. Particular attention is devoted to problems of geometrical image accuracy, optical picture quality, and shutter performance. The optimum solutions to these problems achieved so far in the field of high-resolution lenses with superwide angular field and high-speed shutters are described. It is shown that the development of high-performance lenses and shutters, as well as novel drive, control, and suspension systems in conjunction with plotting instruments of extreme precision, has rendered it possible today to cover the entire surface of the earth cartographically by means of aerial photogrammetry.

O.H.

A70-41401 The land-system concept and pattern in aerial photointerpretation (Das Land-System-Konzept und das Muster ('Pattern') in der Luftbild-Interpretation). Ernst Reiner. *Bildmessung und Luftbildwesen*, vol. 38, Sept. 1, 1970, p. 303-308. 11 refs. In German.

Discussion of the classification of landscapes by way of aerial photointerpretation with the aid of the so-called land-system concept. This concept, developed in Australia by Christian and Stewart (1946, 1968), is based upon identifiable patterns of aerial photographs as they relate to the landscape concerned. The use of the concept as a classification criterion for both natural and cultural landscapes is illustrated by examples and discussed. The distinction to be made, when interpreting aerial photographs, between natural patterns and those appearing in cultural landscapes is pointed out. A model is used for explaining the various levels of landscape and pattern. (Author)

A70-42597 # Analytical spatial aerotriangulation from independent models (Analityczna aerotriangulacja przestrzenna z modeli niezależnych). Leonard Pęczek. *Geodezja i Kartografia*, vol. 19, no. 3, 1970, p. 211-228. In Polish.

Description of an analytical method of spatial aerotriangulation, involving the construction of individual models followed by joint matching of a block of independent models with the points on a given geodesic grid. The individual model is constructed on the basis of known mutual orientation elements of a stereo pair. Transformation of the independent model is based on affine transformation which involves superposition of dilatation and isometry. Matching is based on points of the geodesic grid, common points of neighboring models, and projection centers. T.M.

A70-42963 Critical terrain analysis. Gary T. Hunter (Air-photo Analysis Associates Consultants, Ltd., Toronto, Canada) and S. J. Glenn Bird (Toronto, University, Toronto, Canada). *Photogrammetric Engineering*, vol. 36, Sept. 1970, p. 939-941, 943-952. 13 refs.

Analysis of the physical factors which influence the final image of terrain recorded on color and color infrared aerial films. The solar spectrum, films, filters, processing, camera lenses, focusing, exposure, and terrain characteristics are qualitatively analyzed, and attention is given to the selection of the proper color balance for both color and color infrared photography. The earth's surface is considered under five basic categories of vegetation, exposed soils and rocks, water, snow and ice, and urban areas. The variables, including reflectance characteristics, are examined in detail and illustrated by color photographic examples. T.M.

A70-43089 # Mapping from space images. R. B. Forrest (Bendix Research Laboratories, Southfield, Mich.). *Bendix Technical Journal*, vol. 3, Summer-Autumn 1970, p. 40-47. 20 refs.

Discussion of some of the possibilities and problems associated with mapping from satellite-collected images of the earth. Because existing maps for much of the earth's surface are inadequate, current plans to collect extensive earth-surface data via satellite are of great interest. The applicability of various image sensors is analyzed, and relationships are derived concerning accuracy, resolution, angular coverage, and map content. The importance to the mapping community of evaluating all space images for their mapping potential is stressed. Emphasis is given to optical/mechanical scanner images. M.V.E.

A70-43090 # An orbiting line-scanning system for cartographic data. M. M. Beilock (Bendix Corp., Aerospace Systems Div., Ann Arbor, Mich.). *Bendix Technical Journal*, vol. 3, Summer-Autumn 1970, p. 48-54.

Line-scanning systems in orbiting satellites offer a new tool for maintaining accurate maps of the entire earth, annotated for such spectrally recognizable features as water, snow, vegetation, and cultural areas. This paper discusses design considerations for and the

geometric fidelity attainable with cartographic line scanners suitable for use in such spacecraft as those in the currently planned Earth Resources Technology Satellite (ERTS) series. Ground spatial resolutions of better than 100 feet are shown to be attainable with simple scan mechanisms. For inertially referenced scanners it is shown that, in any 100-by-100-nautical-mile area scanned, no point need have a circular probable error of more than 20 meters with respect to any other point in the image. (Author)

A70-43667 Reformulation of the geodetic boundary value problem in view of the results of geometric satellite geodesy. Karl-Rudolf Koch (U.S. Coast and Geodetic Survey, Geodetic Research and Development Laboratory, Rockville, Md.). In: *Advances in dynamic gravimetry; Proceedings of the Symposium on Dynamic Gravimetry*, Fort Worth, Tex., March 16, 17, 1970. Edited by W. T. Kattner. Pittsburgh, Instrument

Society of America, 1970, p. 111-114; Discussion, p. 114. 7 refs.

Since the shape of the earth can be assumed as given by satellite triangulation methods, the boundary value problem of physical geodesy is reformulated by taking into account that not the surface of the earth but only the gravity field has to be determined. Hence, it is possible to use gravity measurements instead of gravity anomalies as boundary values, so that the approximations in the derivation of the boundary condition of the classical boundary value approach are avoided. The new formulation uses the potential of a simple layer to represent the geopotential and leads to a system of quadratic equations for the unknown density values which can be solved by introducing approximate values for the density. (Author)

A70-45196 # Review of optimal periods for aerial mapping of basic landscape types (Obzor optimal'nykh srokov aerofotografirovaniia osnovnykh tipov landshaftov). B. V. Vinogradov (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR). *Geodezija i Aerofotos'emka*, no. 4, 1969, p. 75-79. 19 refs. In Russian.

Discussion of periods of the year most suitable for aerial mapping of various terrains. Recommendations are given for timing the aerial mapping of the tundra, forest areas, virgin steppe areas, meadows, deserts, and mountainous terrains. The recommendations are based on experiences and published studies concerning various aerial photographic techniques. V.Z.

A70-45197 # Effect of the curvature of the earth on the position of points on an aerial photograph (Vliianie krivizny zemli na polozhenie tochek aerosnimka). I. F. Kushtin (Rostovskii Inzhenerno-Stroitel'nyi Institut, Rostov, USSR). *Geodezija i Aerofotos'emka*, no. 4, 1969, p. 91-97. 5 refs. In Russian.

Analysis of the effects of the curvature of the earth on the position of terrain points on aerial photographs. Expressions are derived to determine the corrections required to obtain the exact positions of point elements on a planar photograph. The value of this correction is estimated for various survey altitudes. It is shown that this value is proportional to the altitude from which photographs are taken. Accuracy requirements for survey altitude measurements are discussed. V.Z.

A70-45199 # Estimation of the optical properties of a terrain for charting the optimal times of aerial mapping (Otsenka opticheskikh svoistv mestnosti s tsel'iu sostavleniia karty optimal'nykh srokov aerofotos'emki). L. A. Bogomolov (Moskovskii Institut Inzhenerov Geodezii, Aerofotos'emki i Kartografii, Moscow, USSR). *Geodezija i Aerofotos'emka*, no. 4, 1969, p. 121-124. In Russian.

Consideration of approaches to the evaluation of the optical properties of areas to be covered by aerial photography, in order to prepare a chart of the optimal timing of this operation. Seasonal variations in contrast levels are discussed for areas of different topography. Atmospheric transmittance as a factor in the timing of aerial surveys is considered. V.Z.

A70-45499 # Field control technique for a planar tying-in of aerial photographs (Sposob polevogo kontrolya planovoi privyazki aerofotomirov). B. G. Bogdanov. *Geodeziya i Kartografiya*, vol. 15, no. 7, 1970, p. 48-50. In Russian.

Description of a method for controlling a planar tying-in process applied to aerial photographs. This method is applicable when the coordinates of reference points are determined by a direct fixing technique. The method is based on a comparison of the obtained free terms of polar conditions with their permissible values during a triangulation. V.Z.

A70-45541 # Results of the analysis of laser measurements in semidynamic geodesy (Résultats du dépouillement des mesures laser en géodésie semi-dynamique). B. Lago (Centre National d'Etudes Spatiales, Brétigny-sur-Orge, Essonne, France). In: Dynamics of satellites; Proceedings of the Symposium, Prague, Czechoslovakia, May 20-24, 1969.

Symposium sponsored by COSPAR, the International Astronomical Union, the International Association of Geodesy, and the International Union of Theoretical and Applied Mechanics. Edited by Bruno Morando. Berlin, Springer-Verlag, 1970, p. 138-146. In French.

Survey of the methods used in space geodesy (nongeometrical geodesy) with three stations located around the Mediterranean when accurate tracking data such as laser or Doppler measurements are available. By using the best value of the perturbations, it is possible to determine the dimensions of the triangle, its location with regard to the center of masses, and its orientation. The first results obtained by elementary laser measurement processes on D1-D are presented. These measurements were made on May 8, 9, and 10, 1967. F.R.L.

A70-45543 # Treatment of Doppler measurements in semidynamic geodesy (Traitement des mesures Doppler en géodésie semi-dynamique). J.-P. Chassaing (Centre National d'Etudes Spatiales, Brétigny-sur-Orge, Essonne, France). In: Dynamics of satellites; Proceedings of the Symposium, Prague, Czechoslovakia, May 20-24, 1969.

Symposium sponsored by COSPAR, the International Astronomical Union, the International Association of Geodesy, and the International Union of Theoretical and Applied Mechanics. Edited by Bruno Morando. Berlin, Springer-Verlag, 1970, p. 154-161. 8 refs. In French.

Demonstration of the results obtained in the field of semidynamic geodesy, by processing of Doppler data collected from three Mediterranean ground stations: Stephanion (STD); Greece, Colomb-Bechar (CBD), Algeria, and Haute-Provence (HPD), France. The orbit parameters, the position of the stations, and one frequency parameter for each station are simultaneously computed with a differential correction calculation using the least squares method. The program of differential correction is based on a numerical integration of the equations of motion (Cowell's method to the 8th order). All the disturbances that have a known effect can be taken into account in the satellite motion theory. F.R.L.

A70-45544 # Comparative analysis of different results on the European datum from spatial geodesy. M. Lefebvre (Centre National d'Etudes Spatiales, Brétigny-sur-Orge, Essonne, France). In: Dynamics of satellites; Proceedings of the Symposium, Prague, Czechoslovakia, May 20-24, 1969.

Symposium sponsored by COSPAR, the International Astronomical Union, the International Association of Geodesy, and the International Union of Theoretical and Applied Mechanics. Edited by Bruno Morando. Berlin, Springer-Verlag, 1970, p. 162-169. 7 refs.

Analysis of results obtained in dynamical and geometrical geodesy on the European net, using Doppler, laser, and photographic measurements during the DIADEME and RCP campaigns. The different measurements are compared, and the scale and orientation of the Europe 50 system is studied. F.R.L.

A70-45545 * Comparisons and combinations of geodetic parameters estimated from dynamic and geometric satellite solutions and from Mariner flights. K. Lambeck (Smithsonian Astrophysical

Observatory, Cambridge, Mass.). In: Dynamics of satellites; Proceedings of the Symposium, Prague, Czechoslovakia, May 20-24, 1969.

Symposium sponsored by COSPAR, the International Astronomical Union, the International Association of Geodesy, and the International Union of Theoretical and Applied Mechanics. Edited by Bruno Morando. Berlin, Springer-Verlag, 1970, p. 170-179. 5 refs. Grant No. NGR-09-015-002.

Combination of three sources of data: the recent SAO dynamic and geometric solutions, and the recent Jet Propulsion Laboratory solutions from Mariner IV and V missions to estimate geodetic parameters. The success of the dynamic solution depends in part on the ability to separate the residuals between observed satellite positions and positions computed from orbital theory into components due to station position errors and due to neglected or incorrect nonzonal harmonic coefficients. The combination of the first two data sets is obviously important for this purpose. The comparison and combination of this satellite solution with the JPL solution is important as the two are essentially independent. Comparison of the individual solutions against the combination indicates that the SAO Baker-Nunn stations' coordinates are determined with an average accuracy of 10 m or better relative to the earth's mass center. F.R.L.

A71-10809 # Theory of the application of artificial earth satellites in solving the problems of higher geodesy (K teorii ispol'zovaniya iskusstvennykh sputnikov zemli dlia resheniya zadach vyshei geodezii). L. B. Zakirov. *Kazanskaia Gorodskaiia Astronomicheskaiia Observatoriia, Trudy*, no. 36, 1969, p. 64-67. 5 refs. In Russian.

Discussion of procedures for determining the dimensions and figure of the earth, the parameters of the gravitational field, and the absolute and relative positions of points on the surface of the earth by using artificial earth satellites as elevated targets of sighting. A theoretical basis for such procedures is outlined. The operation of satellites carrying lasers in such applications is considered. V.Z.

A71-11321 # Gyroscopes in geodesy and aerial photography (Giroskopy v geodezii i aerofotemke). V. Iu. Torochkov. Moscow, Izdatel'stvo Nedra, 1969. 136 p. 71 refs. In Russian.

The fundamentals of the theory of the free gyroscope and of gyroscopic devices is outlined on the basis of structural analysis methods for automatic control systems. Particular attention is given to the physical aspects of gyroscopic phenomena and to sources of gyro error. The structural elements of geodetic gyroscopic instruments and some gyroscopic devices are examined. The kinematic schemes of gyro theodolites with suspensions of various type, of gyro-stabilized aerial photography and aerial photometry devices, and

A71-12463 # Surface density values for the earth from satellite and gravity observations. Karl-Rudolf Koch (ESSA, Geodetic Research and Development Laboratory, Rockville, Md.). *Geophysical Journal*, vol. 21, Oct. 1970, p. 1-12. 19 refs.

The representation of the earth's gravity field as the potential of a simple layer distributed over the surface of the earth is determined by combining satellite observations and gravity anomalies. Density values of the simple layer for 192 surface elements are computed and converted into harmonic coefficients up to the 15th degree and order. These coefficients are used to determine surface density values referred to a reference ellipsoid with the flattening of an earth in hydrostatic equilibrium. The geophysical implications of these values are outlined. (Author)

A71-14008 # Preliminary results of the geodetic campaign R.C.P. 133. G. Balmirio (Meudon, Observatoire, Paris, France), M. Bivas, and M. Lefebvre (Centre National d'Etudes Spatiales, Paris, France). In: Space research X; COSPAR, Plenary Meeting, 12th, and Symposium on Thermospheric Properties Concerning Temperatures and Dynamics with Special Application to H and He, Prague, Czechoslovakia, May 11-24, 1969, Proceedings.

Symposium co-sponsored by the International Association of Geomagnetism and Aeronomy, the International Union of Geodesy and Geophysics, and the International Union of Radio Science. Edited by T. M. Donahue, P. A. Smith, and L. Thomas. Amsterdam, North Holland Publishing Co., 1970, p. 77-80.

In order to determine geometrically the vectors between some stations in Europe, many simultaneous observations of artificial satellites have been carried out. The campaign described involves stations at Meudon, Haute Provence and Nice in France; San Fernando in Spain; and Dionysos in Greece. The observations consisted of laser range measurements and photographic observations of the satellites Geos B, D1D, Geos A, BEB and BEC, all of which have laser reflectors. First results of the few observations reduced are in good agreement with those obtained by the Smithsonian Astrophysical Observatory. (Author)

A71-14207 # Geometry from simultaneous satellite ranging. Leendert Aardoom (Uppsala, Universitet, Uppsala, Sweden). *Tellus*, vol. 22, no. 5, 1970, p. 572-580.

The geometric approach to satellite geodesy through simultaneous observations is discussed in general and as regards pure simultaneous ranging to a satellite in some detail. Closed expressions are derived for the geometric conditions imposed upon a network of satellite tracking stations joining in simultaneous ranging. The mathematical procedure suggested is symmetric in all stations and only involves the unknown distances between them and the measured ranges to a satellite. A comparison is made with similar 1- and 2-dimensional problems. (Author)

A71-14537 * Sudden impulses in the magnetosphere observed at synchronous orbit. V. L. Patel (California, University, Los Angeles, Calif.; Denver, University, Denver, Colo.) and P. J. Coleman, Jr. (California, University, Los Angeles, Calif.). *Journal of Geophysical Research*, vol. 75, Dec. 1, 1970, p. 7255-7260. 11 refs. NSF Grant No. GA-10999; Grant No. NGR-05-007-004.

ATS 1 data on the magnetic field in the equatorial plane at a geocentric distance of 6.6 earth radii have been used to study sudden impulses (si). Fifteen si events that produced effects at ATS 1 were examined. Records on the surface field at high and low latitudes were compared with the ATS 1 record for each event. (Author)

A71-15066 # Earth's ellipsoid and some physical constants related to it (Elipsoida ziemska i niektóre stałe fizyczne z nią związane). Tadeusz Olczak (Warszawa, Uniwersytet, Warsaw, Poland). *Acta Geophysica Polonica*, vol. 18, no. 3-4, 1970, p. 299-323. 148 refs. In Polish.

Discussion of the values of physical constants characterizing the earth's ellipsoid from the viewpoint of improvements made possible by satellite measurements of the geocentric gravitational constant, the earth-moon mass ratio, and the geopotential harmonic coefficients. New values are suggested for the earth's oblateness, the equatorial radius, gravity distribution over the ellipsoid surface, dynamic flattening, and moments of inertia. Comparison is made with previous values and expressions which were not based on the satellite data. T.M.

A71-15302 Survey improvement using satellite data. N. Bush (Pan American World Airways, Inc., Patrick AFB, Fla.) and D. R. Pfingsten (RCA International Service Corp., Patrick AFB, Fla.). In: Space sciences - Future applications for mankind; Vandenberg Scientific and Technical Societies Council, Western Space Congress, 1st, Santa Maria, Calif., October 27-29, 1970, Proceedings. Part 1. North Hollywood, Calif., Western Periodicals Co., 1970, p. 376-390. 15 refs.

Survey adjustments and improved survey accuracies were obtained for four AFETR downrange Mistran/MRS sites. Data used were radar range-only and ballistic camera data. Data from Geos B, Echo II, and Pageos were combined with previous data from Geos A, Anna, and Minuteman to produce a combined weighted mean survey adjustment. Some results are also shown for survey qualification using a Minuteman III test with the old and new survey values.

A71-15304 Rapid determination of geodetic position. E. Joyce Greeley (U.S. Naval Material Command, Naval Weapons Laboratory, Dahlgren, Va.). In: Space sciences - Future applications for mankind; Vandenberg Scientific and Technical Societies Council, Western Space Congress, 1st, Santa Maria, Calif., October 27-29, 1970, Proceedings. Part 1. North Hollywood, Calif., Western Periodicals Co., 1970, p. 403-405.

A study was conducted to determine the accuracy achievable in determining the three components of the geodetic position of a site in the minimum time possible, the time required to receive and analyze data from two Doppler satellite passes. If only the satellites now in orbit are considered, this time interval ranges from one to five hours. While current geodetic positioning methods require a one-week span of satellite observations, the study showed that 20 meter accuracy could be obtained in just a few hours. (Author)

A71-15306 * The earth's gravitational environment at synchronous altitudes. Carl A. Wagner (NASA, Goddard Space Flight Center, Greenbelt, Md.). In: Space sciences - Future applications for mankind; Vandenberg Scientific and Technical Societies Council, Western Space Congress, 1st, Santa Maria, Calif., October 27-29, 1970, Proceedings. Part 1. North Hollywood, Calif., Western Periodicals Co., 1970, p. 421-426. 21 refs.

Observation of the long-term drift of eight synchronous satellites since 1963, in conjunction with lower altitude satellite data, has served to define the gravitational environment at synchronous altitudes to high accuracy. This knowledge is essential to the precise control of the many geostationary satellites planned for the 1970s. As an example of the results from observation of the existing satellites, the four equatorial equilibrium points controlling the long-term east-west motion of the geostationary satellite have now been located to within 1/2 degree. (Author)

A71-18294 New devices for digitizing photogrammetric models (Neue Instrumente zur Digitalisierung von photogrammetrischen Modellen). R. Schwebel (Carl Zeiss, Oberkochen, West Germany). *Bildmessung und Luftbildwesen*, vol. 39, Jan. 1, 1971, p. 48-54. 5 refs. In German.

Description of the ECOMAT-11 digitizing system developed by Carl Zeiss, Oberkochen, which makes possible point-, line-, and surface-digital acquisition of data obtained photogrammetrically. This is done by incremental recordings in constant coordinate and time intervals and the DTM-1 and DTM-2 measuring accessories. The ECOMAT-11 system is especially suited for digital mapping and measurement of digital terrain models. O.H.

A71-21239 American Society of Photogrammetry and American Congress on Surveying and Mapping, Technical Conference, Denver, Colo., October 7-10, 1970, Proceedings. Falls Church, Va., American Society of Photogrammetry, 1970. 547 p. Members, \$2.50; nonmembers, \$5.00.

Coverage includes aerial photography for reforestation surveys, multispectral television for reconnaissance, the location and orientation of lunar astronauts, the generation of profile maps by computer, trilateration technique, small-scale aerial and space photography for resource surveys, and computer graphics in cartography. A stereoscopic technique of profiling by intersection of ray traces is outlined. A prototype of a digital image-processing system for terrain pattern recognition is described, as well as an integrated stereotriangulation system and a recently developed camera calibration facility.

Individual items are abstracted in this issue. A.B.K.

A71-21252 Stereoscopic profiling by intersection of ray traces. James G. Lewis and Thomas A. Hughes (U.S. Geological Survey, Topographic Div., McLean, Va.). In: American Society of Photogrammetry and American Congress on Surveying and Mapping, Technical Conference, Denver, Colo., October 7-10, 1970, Proceedings. Falls Church, Va., American Society of Photogrammetry, 1970, p. 248-255.

A unique method is described for automatically obtaining a photographic record of terrain profiles from a stereoscopic pair of

aerial photographs. The scanning-exposing process involves a model composed of enhanced positive and negative images. The instrumentation and procedures used to investigate the feasibility of the method are described and illustrated. A review of profiling experiments conducted in the recent past is followed by a discussion of possible applications and proposed production equipment.

(Author)

A71-21253 A cartographer inventories environment - The CLARI project. Arthur J. McNair. In: American Society of Photogrammetry and American Congress on Surveying and Mapping, Technical Conference, Denver, Colo., October 7-10, 1970, Proceedings. Falls Church, Va., American Society of Photogrammetry, 1970, p. 276-295.

Description of CLARI, the Colorado Land Use and Environmental Resource Inventory Project. The entire state is being inventoried under the broad classifications accepted nationally for land use and natural resources - namely: (1) Hydrology and Water Resources, (2) Geology and Mineral Resources, (3) Forestry and Agricultural Resources, (4) Geography and Human or Cultural Resources, and (5) Cartography and Mapping Requirements. More than 150 categories of items are being inventoried, primarily by airphoto interpretation, in each of approximately 3000 cells or blocks into which the state has been divided. The inventory categorizes the three principal subdivisions of percentage of coverage in each cell on an area basis, miles of linear features in a cell, and number of occurrences of point features in each cell. M.M.

A71-21257 External block adjustment of planimetry. G. H. Schut (National Research Council, Div. of Physics, Ottawa, Canada). In: American Society of Photogrammetry and American Congress on Surveying and Mapping, Technical Conference, Denver, Colo., October 7-10, 1970, Proceedings. Falls Church, Va., American Society of Photogrammetry, 1970, p. 379-400. 10 refs.

This paper discusses current methods for the adjustment to ground control of an internally adjusted block and related methods for the determination of a surface from its heights at discrete points. A new method for planimetric block adjustment is developed from one of the latter. However, a distinguishing feature of the method is the adjustment of planimetric position rather than that of the coordinates separately. The method is easily programmed and is suitable for a very small computer. For experimental purposes, the method has been combined with an internal block adjustment consisting in polynomial transformation of strips. Results are compared with those obtained with the standard polynomial block adjustment used at the author's organization. (Author)

A71-21799 Physical geodesy. Urho A. Uotila (Ohio State University, Columbus, Ohio). *EOS*, vol. 52, Mar. 1971, p. IUGG 12-IUGG 16. 92 refs.

Brief review of books published on a limited area of physical geodesy since 1967. Some of the topics treated are an alternative representation of the earth's gravitational field for satellite geodesy, linear solutions of the boundary-value problem, the geodetic aspects of the interrelation of gravitation and inertia, a general theory of gravity processing, the analysis of terrestrial gravity data, the use of geophysical information in the computation of mean anomalies, and new ideas of using satellites for obtaining localized features of the gravity field. M.M.

A71-21800 Satellite geodesy - Methods. B. H. Chovitz (National Oceanic and Atmospheric Administration, Geodetic Research and Development Laboratory, Rockville, Md.). *EOS*, vol. 52, Mar. 1971, p. IUGG 27-IUGG 29. 51 refs.

Brief review of the methods used in obtaining analytic solutions for the motion of a near-earth satellite which are of practical importance for orbit prediction and establishment of reference orbits for minimizing perturbations from which the geodetic information is extracted. Developments in the formulation of alternatives to the

spherical harmonic representation of the gravity field are surveyed, together with methods of satellite geodetic data acquisition, and methods of solution for gravity field and station positions. M.M.

A71-21801 Satellite geodesy - Results. E. M. Gaposchkin (Smithsonian Astrophysical Observatory, Cambridge, Mass.). *EOS*, vol. 52, Mar. 1971, p. IUGG 30-IUGG 33. 66 refs.

Brief review of the satellite techniques used in the calculation of the relative coordinates of several tracking stations and in gravity-field determinations since 1966. The data used in combination solutions from nonsatellite sources are described, the results of combinations are reviewed, and the best information available is summarized. A bibliography lists only papers published by journals or distributed by private organizations as part of their programs. M.M.

A71-23207 American Society of Photogrammetry, Annual Meeting, 37th, Washington, D.C., March 7-12, 1971, Technical Papers. Falls Church, Va., American Society of Photogrammetry, 1971. 827 p. Members, \$5.00; nonmembers, \$10.00.

Photogrammetry, as used in mapping, topographical studies, agriculture and forestry surveys; geodesy; and new films are treated. Radar techniques adapted to photogrammetry, and the uses of photogrammetry in lunar, and planetary mapping and underwater studies, are discussed. F.R.L.

A71-23216 Cumulative frequency curves of terrain slopes from radar shadow frequency. Anthony J. Lewis (Louisiana State University, Baton Rouge, La.) and William P. Waite (Arkansas University, Fayetteville, Ark.). In: American Society of Photogrammetry, Annual Meeting, 37th, Washington, D.C., March 7-12, 1971, Technical Papers. Falls Church, Va., American Society of Photogrammetry, 1971, p. 228-244. Grant No. DA-AK-02-68-C-0089.

Description of the radar shadow frequency method for determining the distribution of terrain slopes and the basis for its use. The results of the comparison of map-derived and radar-derived slopes are evaluated. It appears that the radar-derived slope curves are comparable to topographic map-derived slope distribution curves, and seem to be more realistic in mountainous regions. The method was tested in six regions in the U.S. where both radar imagery and topographic maps were available. F.R.L.

A71-23219 Cartographic applications of synthetic aperture radar. L. C. Graham (Goodyear Aerospace Corp., Litchfield Park, Ariz.). In: American Society of Photogrammetry, Annual Meeting, 37th, Washington, D.C., March 7-12, 1971, Technical Papers. Falls Church, Va., American Society of Photogrammetry, 1971, p. 417-450.

Description of the cartography characteristics of airborne radar sensors developed by Goodyear Aerospace. Electronic techniques and equipment have been developed to perform topographic mapping under adverse weather conditions. The techniques include airborne data acquisition of both imagery, for detail extraction, and position measurement, for detail location. Cartographic characteristics of the airborne radar sensor configurations, including resolving power and measurement accuracy, are found to be adequate for small and medium scale mapping. O.H.

A71-23860 A French project to aid in geodesy - The Geole spatial system: Utilization in the polar zones (Un projet français d'aide à la géodésie - Le système spatial Géole: Utilisation dans les zones polaires). J.-C. Husson, D. Thieret, and R. Bost (Centre National d'Etudes Spatiales, Paris, France). *La Recherche Spatiale*, vol. 9, Dec. 1970, p. 1-6. In French.

Feasibility study of the applicability of the Eole balloon tracking system to geodesy. The Eole system for tracking wind tracer balloons comprises a satellite and hundreds of transponder beacons

carried by the balloons. The Geole (Geodesy and Eole) project involves improvement of the accuracy by a factor of 1000, and replacing the balloon nacelles by ground beacons. The system may be considered as the association of a satellite with the ground beacons, a telemetry receiving station on the ground, and a computer. A fundamental calibration base is the standard polyhedral, which can be rapidly determined by a mixture of distance measurements and Doppler measurements. It is considered that Geole would be of great interest in the polar zones in the fields of glaciology, meteorology, and seismology. F.R.L.

A71-25806 Observations of artificial earth satellites. Number 9 (Nabliudeniiia iskusstvennykh sputnikov zemli. Number 9). Edited by W. Dobaczewska. Warsaw, Polska Akademia Nauk, 1970. 396 p. In Russian, German, and English.

Review of satellite observations for geodetic use, application of celestial mechanics to the determination of satellite orbits, satellite studies of the upper atmosphere, and observation instruments and procedures. Among the topics considered are the theory of motion of artificial earth satellites, secular perturbations in the motion of such satellites, topocentric trajectories of satellites, the determination of orbital elements of satellites, the determination of the difference between quasi-draconic and draconic orbital periods of satellites, methods of space triangulation and satellite geodesy, studies of atmospheric temperature and density fluctuations, and descriptions of photographic equipment used in conjunction with satellite observations.

A.B.K.

A71-25813 # Transformation of geodetic geographic coordinates and ellipsoid heights and determination of the ellipsoid azimuth and the length of the geodetic line by means of synchronous observations of satellites (Perenesenie geodezicheskikh geograficheskikh koordinat, ellipsoidnykh vysot i opredelenie ellipsoidnogo azimutha i dliny geodezicheskoi linii pri pomoshchi sinkhronnykh nabliudenii sputnikov). N. Georgiev and I. Totomanov. In: Observations of artificial earth satellites. Number 9 (Nabliudeniiia iskusstvennykh sputnikov zemli. Number 9). Edited by W. Dobaczewska. Warsaw, Polska Akademia Nauk, 1970, p. 107-119. 7 refs. In Russian.

Description of a method for transforming geodetic geographic coordinates and ellipsoid heights and determining the ellipsoidal azimuth and the length of the geodetic line between two observation stations by means of synchronous photographic observations and simultaneous measurements of distances to artificial satellites. It is assumed that the geodetic geographic coordinates and the ellipsoid height of the first station are known. From the derived geometrical relation between the radius vectors to the satellite, the transverse radii of curvature, and the heights of the two observation stations above the ellipsoid, a vector conditional equation with unknowns for each position of the satellite is obtained. For a unique solution of the problem it is sufficient to have one measured value of the distance to the satellite and to know the equatorial topocentric coordinates of the satellite for the synchronous moment of a single position of the satellite. Formulas are derived for determining the geodetic geographic coordinates and the ellipsoid height of the second station by means of equalization by the method of least squares. A.B.K.

A71-25817 # Checking the geodetic azimuth between two remote points (Kontrol' geodezicheskogo azimutha mezhdu dvumia udalennymi punktami). F. Hovorka. In: Observations of artificial earth satellites. Number 9 (Nabliudeniiia iskusstvennykh sputnikov zemli. Number 9). Edited by W. Dobaczewska. Warsaw, Polska Akademia Nauk, 1970, p. 181-189. In Russian.

A direct method of determining the azimuth between two points on the earth's surface, using the geodetic coordinates of the observation stations and the topocentric equatorial coordinates of synchronous directions toward a satellite as the input data, is proposed. These data are used to determine directly the correction of the geodetic azimuth of the connecting line between the stations. A

means of greatly reducing the influence of inaccuracies in time determinations (synchronization) is described. As an example, the azimuth between two observation stations is calculated on the basis of 86 synchronous satellite positions on four pairs of photographs.

V.P.

A71-25820 # Results in satellite geodesy. J. Rolff. In: Observations of artificial earth satellites. Number 9 (Nabliudeniiia iskusstvennykh sputnikov zemli. Number 9). Edited by W. Dobaczewska. Warsaw, Polska Akademia Nauk, 1970, p. 209-214.

The progress of satellite geodesy over the 12 years since the advent of artificial earth satellites is assessed in terms of accuracy of gravitational field and station position measurements. The precision of 10 m reached in the determination of the Baker-Nunn stations is noted as one of the achievements of satellite geodesy. Geodetic solutions obtained by different groups using optical, Doppler and laser techniques are compared and are shown to differ appreciably. The differences in the Polar Motion determinations made by IPMS and BIH and the doubtfulness of published UTC-UT1 data are indicated as examples. It is maintained that the influence of systematic errors should be studied with utmost care to improve the accuracy of present measurements. V.Z.

A71-25832 # Relativistic effects and optimalization in Doppler geodetical measurements. G. Tarcsai and F. Horvát. In: Observations of artificial earth satellites. Number 9 (Nabliudeniiia iskusstvennykh sputnikov zemli. Number 9). Edited by W. Dobaczewska. Warsaw, Polska Akademia Nauk, 1970, p. 375-383.

Using model computations, the relation between the azimuth and elevation of the satellite at its closest approach, on the one hand, and the accuracy in the determination of coordinates on the other is derived, with allowance for the relativistic components of the Doppler shift. It is shown that for determining all coordinates to about the same accuracy, the optimum inclination selected should be one at which the overhead passage of the satellite is seen in the NE(SW) or NW(SE) directions. Z.W.

A71-27256 Improved aerial mapping efficiency through the use of precision inertial navigation. Robert L. Berquist (Bell Aerospace Co., Buffalo, N.Y.) and Anthony R. Pate. In: International Society of Photogrammetry, American Society of Photogrammetry, and Ohio State University, International Symposium on Photogrammetry and Navigation, Columbus, Ohio, May 25-28, 1970, Proceedings. Edited by S. K. Ghosh. Columbus, Ohio State University, 1971, p. 41-61; Discussion, p. 61.

The actual flight test data of the Hipernas IIB Inertial Navigation System as it is used in the AN/USQ-28 Geodetic Mapping and Survey System are used as a reference in the discussion. Methods of flight line control used to achieve 10% photographic side-lap are discussed in detail. These methods involve the use of a Precision Inertial Navigator in both the pure and the aided modes. The usefulness of the equipment is further explored in connection with the automatic capability of accurately side-lapping a line photographed on a previous day. The subject of verticality is covered in detail supported with a summary of flight test results which shows a 30 seconds of arc verticality capability. The application of this accurate vertical reference is for camera mount stabilization and the automatic in-flight recording of tip and tilt data for each photograph. G.R.

A71-29903 * Geomagnetic models from satellite surveys. Joseph C. Cain (NASA, Goddard Space Flight Center, Greenbelt, Md.). *Reviews of Geophysics and Space Physics*, vol. 9, May 1971, p. 259-273. 91 refs.

The use of satellite scalar magnetic field data to produce geomagnetic field models is reviewed. There have been nine separate spacecraft that have acquired observations of the geomagnetic field

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from low (less than 1500 km) satellite altitudes since 1958. The magnetic field models produced from such data have not been sufficiently compared with surface-vector data to firmly establish their validity. One comparison has indicated that satellite-derived models are as valid over-all as those produced from surface data. Variations in the field components are shown to be larger than those in scalar field by factors of 4-10. Recent satellite models indicate an increase in dipole decay to ~ 27 gammas/year, a value that may be plausible, judging from extrapolation of earlier surface-derived models. Also noted is a recent slowing of eccentric dipole westward drift. (Author)

A71-33368 # Satellite geodesy in the Netherlands (Satellietgeodesie in Nederland). Th. J. Poelstra (Delft, Technische Hogeschool, Delft, Netherlands). *Ruimtevaart*, vol. 20, June 1971, p. 47-58. In Dutch.

Possible approaches to satellite geodesy are considered, and available techniques of measurement and their accuracy are discussed. Instrumentation used in satellite geodesy is briefly reviewed, and the equipment and operation of the ground station at Ypenburg, which performs observations of both optically passive and active satellites, is described. Three international satellite programs in which the station at Ypenburg participates, are characterized. Planned improvements in this field are outlined. O.H.

A71-33539 # The intersection of a cone and a sphere - A contribution to the geometry of satellite viewing. I. Ruff (NOAA, Meteorological Satellite Laboratory, Washington, D.C.). *Journal of Applied Meteorology*, vol. 10, June 1971, p. 607-609.

The problem of the geometry of viewing the earth from a satellite which requires a solution of the intersection of a sphere and a cone which has an arbitrary orientation relative to the sphere is examined. Equations for the intersection are presented, and relationships for expressing the intersection curves in geographic coordinates are developed. O.H.

A71-34470 # Methods of satellite geodesy (Methoden der Satellitengeodäsie). Kurt Arnold. Berlin, East Germany, Akademie-Verlag GmbH, 1970. 243 p. 159 refs. In German.

This book discusses the whole field of satellite geodesy. A brief introduction to the two-body problem is provided, and the theory of perturbations of the orbits of artificial earth satellites is considered. The perturbations are caused by the gravitational field of the earth, gravitational effects of sun and moon, braking effects of the atmosphere, and the radiation pressure of the sun. Observation methods and satellites important for geodetic applications are briefly described. Coordinate systems and reduction procedures are discussed together with the computation of the ephemerides of the earth satellites. The various methods of geometric satellite geodesy for the determination of geodetic nets are considered, and the approaches of dynamical satellite geodesy are examined. G.R.

A71-35028 New solution for the anomalous gravity potential. H. Baussus-von Luetzow (U.S. Army, Engineer Topographic Laboratories, Fort Belvoir, Va.). *Journal of Geophysical Research*, vol. 76, July 10, 1971, p. 4884-4891. 22 refs.

This note is a symbiosis of classical and modern gravimetric geodesy. The formulas obtained are almost equivalent to those of Molodensky and Brovar but are less data dependent, more direct from the computational point of view, and more advantageous for the utilization of artificial satellite data. Because of the inclusion of terms involving a nonvanishing topographic mean density, the new theory is more general than the method of Bjerhammar and not subject to a growing bias with decreasing wavelength. It also has ramifications for simplified models and model combinations derived or proposed by other authors. (Author)

A71-35763 Sidelooking radiometry - A new approach to passive mapping of terrain. Sidney Kazel and Robert J. Serafin (IIT Research Institute, Chicago, Ill.). In: NAECON '71; Institute of Electrical and Electronics Engineers, National Aerospace Electronics Conference, Dayton, Ohio, May 17-19, 1971, Proceedings.

New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 76-83.

A sidelooking radiometry technique is described which stores the signals passively received from various terrain elements over an extended flight path. Subsequent processing of the stored data results in radiometric terrain maps of greater resolution than is obtainable from conventional, 'downlooking' radiometry. (Author)

A71-36492 Geodetic application of satellite data. Thomas O. Seppelin (USAF, Aeronautical Chart and Information Center, St. Louis, Mo.). In: Technology today and tomorrow; Canaveral Council of Technical Societies, Space Congress, 8th, Cocoa Beach, Fla., April 19-23, 1971, Proceedings. Volume 2.

Edited by N. A. Stein. Cape Canaveral, Canaveral Council of Technical Societies, 1971, p. 15-1 to 15-9.

Discussion of the activities currently pursued in geodetic satellite data utilization, and review of the results so far achieved. The investigations conducted fall into two categories which support the development of a World Geodetic System both directly and indirectly. The geometric application is engaged in specific point positioning for the test ranges and the densification of geodetic control in South America. The dynamic application is concerned primarily with the determination of an earth gravitational model and tracking station locations from a combination of optical and electronic data supplemented with existing surface gravity anomalies. The status of the various efforts is described. Test objectives are presented, along with results of simulated data from proposed geocenter deployment schemes. M.V.E.

A71-37302 # Possibilities of using orbiting stations for cartographic and geodetic purposes (Possibilità di utilizzazione delle stazioni orbitali a fini cartografici e geodetici). Giuseppe Birardi (Istituto Geografico Militare, Florence, Italy). In: Prospects in the next decade for the use of orbiting stations and space shuttles; Technical and Scientific International Space Convention, 11th, Rome, Italy, April 1-3, 1971, Proceedings (Prospettive nel prossimo decennio per la utilizzazione delle stazioni orbitali e delle navette spaziali; Convegno Internazionale Tecnico-Scientifico sullo Spazio, 11th, Rome, Italy, April 1-3, 1971, Atti). Convention sponsored by the Ministero degli Affari Esteri and the Associazione Industrie Aerospaziali. Rome, Rassegna Internazionale Elettronica Nucleare e Teleradiocinematografica, 1971, p. 47, 49-56. 8 refs. In Italian.

Brief review of studies of the possibility of the application of artificial satellites to mapping of the land from space. It is pointed out that, although the mapping and geodetic application does not have a primary importance among the possible uses of orbital stations, it will have immense usefulness for human progress and well being. The difficulties of this problem include technological photographic difficulties, as well as practical difficulties in the restitution, drawing, and printing of the huge volume of frames and videograms that might be supplied in a short time by orbiting stations. However, it is pointed out that the use of orbiting stations for mapping is technically possible and has good possibilities of practical implementation, particularly from the standpoint of its military application. M.M.

A71-39656 * # Application of space techniques to solid-earth and ocean physics. C. A. Lundquist (Smithsonian Astrophysical Observatory, Cambridge, Mass.). In: Space research XI; COSPAR, Plenary Meeting, 13th, and Symposium on Remote Sounding of the Atmosphere, Leningrad, USSR, May 20-29, 1970, Proceedings. Volume 1.

Meeting and Symposium co-sponsored by the International Union of Geodesy and Geophysics and the World Meteorological Organization. Edited by K. Ia.

Kondrat'ev, M. J. Rycroft, and C. Sagan. Berlin, East Germany, Akademie-Verlag, 1971, p. 439-456. 38 refs. Grant No. NGR-09-015-002.

Possible applications of satellite data in earth geometry and kinetics studies are discussed. Recent technique and instrumentation advances in this field are reviewed with particular attention to geopotential models, pole positions, the angular position of the earth about its axis, and earth tides. Short-term and long-term dynamics of the earth, ocean physics and international cooperation in satellite applications to their studies are also considered in general terms. V.Z.

A71-39661 # Determination of a geodetic base at long distance (*Détermination d'une base géodésique à longue distance*). A. Cazenave (Centre National d'Etudes Spatiales, Paris, France) and O. Dargnies (Meudon, Observatoire, Meudon, Hauts-de-Seine, France). In: Space research XI; COSPAR, Plenary Meeting, 13th, and Symposium on Remote Sounding of the Atmosphere, Leningrad, USSR, May 20-29, 1970, Proceedings. Volume 1. Meeting and Symposium co-sponsored by the International Union of Geodesy and Geophysics and the World Meteorological Organization. Edited by K. Ia. Kondrat'ev, M. J. Rycroft, and C. Sagan. Berlin, East Germany, Akademie-Verlag, 1971, p. 499-505. 9 refs. In French.

Determination of a base triangle by geometric geodesy with an accuracy of the order of 1:1,000,000. The simultaneous observation of a satellite from stations performing either laser distance measurements or photographs of the satellite on a star background makes it possible to determine the vectors joining these different stations by a purely geometrical method. Within the framework of the Europe-Africa geodetic link it was necessary to define exactly a geodetic triangle based in Europe by simultaneous use of laser telemetry and optical observations on satellites fitted with cataphotic reflecting prisms. Results relative to the San Fernando (Spain)-Haute Provence (France)-Dionysos (Greece) triangle are presented. F.R.L.

A71-39663 # Condensation of observational data with a view to geodetic utilization (*Condensation des données d'observation en vue d'une utilisation géodésique*). B. Lago and A. M. Maingué (Centre National d'Etudes Spatiales, Brétigny-sur-Orge, Essonne, France). In: Space research XI; COSPAR, Plenary Meeting, 13th, and Symposium on Remote Sounding of the Atmosphere, Leningrad, USSR, May 20-29, 1970, Proceedings. Volume 1. Meeting and Symposium co-sponsored by the International Union of Geodesy and Geophysics and the World Meteorological Organization. Edited by K. Ia. Kondrat'ev, M. J. Rycroft, and C. Sagan. Berlin, East Germany, Akademie-Verlag, 1971, p. 515-519. In French.

Proposal of an original method for condensing data obtained from geodetic satellites. Generally, a typical Doppler pass contains 100 to 150 individual data points, and a laser pass 200 to 250 points; the method consists in substituting for all the measurements of a pass above a station, one pseudomeasurement, expressed by a vector involving at most six components. This method has been applied to laser and Doppler experimental data of the Diadème satellite. The results obtained after a semidynamical geodesy treatment using the pseudomeasurements are compared with the results obtained during the same period using real measurements. These are shown to be equivalent, and should be useful in dynamical geodesy. F.R.L.

A71-39687 # Study of the connection between the characteristics of the earth's surface and some meteorological elements from the global pictures from the automated Interplanetary station Zond 7. A. A. Grigor'ev, V. B. Lipatov, and B. V. Vinogradov (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR). In: Space research XI; COSPAR, Plenary Meeting, 13th, and Symposium on Remote Sounding of the Atmosphere, Leningrad, USSR, May 20-29, 1970, Proceedings. Volume 1. Meeting and Symposium co-sponsored by the International Union of Geodesy and Geophysics and the World Meteorological Organization. Edited by K. Ia. Kondrat'ev, M. J. Rycroft, and C. Sagan. Berlin, East Germany, Akademie-Verlag, 1971, p. 727-730.

Interpretation of color space photographs obtained from the Soviet automated station Zond 7 on Aug. 8, 1969. Two gigantic dust and sand movements (dust-sand flows) on the Arabian peninsula are noted. One of these dust-sand flows is associated with the trade wind movement, and the other with monsoon circulation. It is found that the large-scale relief of the Arabian peninsula, Asia Minor, and Iran influences the orientation of these movements. An integrated analysis of one of these photographs also reveals a close connection between the orientation of dust-sand flows and the direction of the longitudinal dunes (seifs) of Arabia. A.B.K.

A71-40584 # On geodetic surveying of the earth with the aid of satellites. Kurt Arnold (Deutsche Akademie der Wissenschaften, Zentralinstitut für Geophysik, Berlin, East Germany). *Jena Review*, vol. 16, no. 3, 1971, p. 196-199.

The fundamentals of geometric satellite geodesy (space triangulation) and dynamic satellite geodesy (orbital method) are outlined. Diagrams for simultaneous satellite observations from two and three stations are presented. A new method of dynamic satellite geodesy is described, in which mean values for the gravity anomalies of square areas (20 x 20 deg) on the earth surface are used as parameters for the gravitational field. The method is particularly effective when used with small-diameter large-weight satellites, which however are difficult to observe because of their small light intensity. A special camera developed for such observations is described. V.P.

A71-40875 # Onboard aerial photography equipment (*Bortovye sredstva vozdušnogo fotografirovaniia*). S. V. Knorozov. In: Geodesy and aerial photography 1969 (*Geodeziia i aeros'emka 1969*). Edited by A. V. Kondrashkov. Moscow, Izdatel'stvo VINITI, 1970, p. 86-118. 146 refs. In Russian.

Aerial photographic equipment covered by the Soviet abstract magazine 'Geodeziia' from 1963 through 1968 is reviewed. Brief descriptions are given for topographic aerial cameras, aerial photograph orientation equipment, onboard navigation instruments, and the AN/USQ-28 mapping survey system. V.Z.

A71-43014 # Refined geodetic results based on Doppler satellite observations. R. J. Anderle (U.S. Navy, Naval Weapons Laboratory, Dahlgren, Va.). *American Astronautical Society and American Institute of Aeronautics and Astronautics, Astrodynamics Specialists Conference, Ft. Lauderdale, Fla., Aug. 17-19, 1971, AAS Paper 71-341*. 67 p. 20 refs. (NWL-TR-2889)

Locations of Doppler satellite observing stations have been recomputed to determine a set which is more self-consistent and more consistent with the CIO pole. The motion of the earth's pole computed on the basis of these coordinates agrees with the astronomical determinations to about one meter, while the coordinates of individual stations determined on the basis of five days of observations of one satellite show a consistency of about two meters. Solutions for the positions of a station based on two satellite passes observed within a few hours were found to be accurate to about ten meters. (Author)

A72-10455 Photogrammetric geodesy. G. C. Tewinkel (NOAA, National Ocean Survey, Rockville, Md.). In: American Society of Photogrammetry, Fall Convention, Symposium on Computational Photogrammetry, San Francisco, Calif., September 7-11, 1971, Proceedings. Falls Church, Va., American Society of Photogrammetry, 1971, p. 315-334. 19 refs.

Precision photogrammetric techniques, coordinated with classical geodetic surveys, may be appropriate for expediting control surveys at moderate cost. Accuracy can be specified to meet the needs and resources of the user by varying the scale - e.g., an rms error of 1 in. has been obtained at 1:10,000, and 2 feet at 1:70,000. The techniques include premarking all the ground points used in the analysis, blocks of photographs which have 80% overlap in both directions, and applying an adjustment which includes all the photos and points simultaneously. The solution for the variance-covariance

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values indicates what errors can be expected at each point based on the number of photos and control points. Several relevant systems are in current operation. (Author)

A72-10460 Thematic mapping in the EROS program. D. T. Edson (U.S. Geological Survey, Topographic Div., McLean, Va.). In: American Society of Photogrammetry, Fall Convention, Symposium on Computational Photogrammetry, San Francisco, Calif., September 7-11, 1971, Proceedings. Falls Church, Va., American Society of Photogrammetry, 1971, p. 554-565.

Many users of remote-sensed data must depend on theme-extraction techniques for the proper analysis of a particular phenomenon. The EROS program is developing a thematic mapping system which will produce binary graphic overlays of selected phenomena. The themes to be extracted include (1) open water, (2) snow and ice, (3) reflective infrared vegetation, and (4) the massed works of man. Theme extraction is accomplished by digital, video (analog), and photochemical (analog) techniques. Design criteria are outlined, and preprocessing operations are detailed together with the thematic map formats utilized. T.M.

A72-11783 # Areal mapping program of the IBP Grassland Biome - Remote sensing of the productivity of the shortgrass prairie as input into biosystem models. L. D. Miller and R. L. Pearson (Colorado State University, Fort Collins, Colo.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 165-205. 16 refs.

Discussion of the U.S. International Biological Program (IBP) Grassland Biome Program, which is a major ecosystem analysis describing the functioning of natural grasslands. The initial objective of this effort has been to design and test a multifaceted approach to measure and map per cent cover of areas ranging from small sample grassland plots to much larger landscapes. The amount of vegetation on a prairie can be measured by its characteristic spectroradiance or spectrorreflectance. A variety of approaches to exploiting this relationship is studied, including the use of airborne and satellite multispectral scanner imagery, aerial and ground photography, and ground spectrometry. F.R.L.

A72-11796 # Susceptibility of environments to low resolution imaging for land-use mapping. D. S. Simonett (Sydney, University, Sydney, Australia) and J. C. Coiner (Kansas, University, Lawrence, Kan.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 373-394. 7 refs. U.S. Geological Survey Contract No. 14-08-0001-12077.

To determine basic resolution level requirements for thematic mapping, the spatial frequency distributions of landscape categories of 106 county sites representing environments spread through the United States were analyzed, and the distributions obtained were related to expected Earth Resources Technology Satellite (ERTS) resolutions. To accomplish this, a system of classification has been developed for the levels of environmental complexity in the United States to be imaged by ERTS. Each level of complexity is reviewed to determine which factors control the environmental transfer function. The levels of complexity are then assigned a resolution level for discrimination of a predetermined category of information. O.H.

A72-11821 # A mm-wave scanning radiometer for terrain mapping. K. Künzi, M. Wüthrich, and E. Schanda (Bern, Universität, Berne, Switzerland). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 2. Ann Arbor, University of Michigan, 1971, p. 865-868.

A narrow-beam, microwave radiometer working at 94 GHz with a real-time TV display for terrain mapping is described. The research areas for this instrument are mentioned. Further, a survey of the mathematical analysis of the blurring of contours or measured objects through the antenna pattern and the output integration are given. This effect is demonstrated by scanning a point source. (Author)

A72-11836 # The recognition of earth surfaces by means of infrared imagery taken from the earth satellite, Meteor. B. V. Vinogradov and A. A. Grigor'ev (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 2. Ann Arbor, University of Michigan, 1971, p. 1275-1281. 16 refs.

Earth feature recognition potential provided by IR photographs of the Meteor earth satellite is evaluated. The earth surface features covered include the Himalayas, the Indo-Ganges depression, Tibet, the Jungar and Tarim basins in Central Asia, the mountain ranges of Middle and Central Asia, and the Caspian-Turanian region. It is concluded that spacecraft-transmitted IR images of earth surface formations reflect combinations of several contributing factors, such as relief detail altitudes, topsoil physical properties, vegetation density and moisture content. The difficulty experienced in IR image interpretation, due to these factors, is noted. V.Z.

A72-11874 # Computerized land pattern mapping from mono-imagery. C. W. Johnson (California, University, Riverside, Calif.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 1951-1965. Contract No. N00014-69-A-200-5001. Project THEMIS.

Description of the coordinate digitizer which offers the prospect of a relatively low cost method for the image analyst to create precisely located planimetric computer input data from satellite and high altitude imagery. The coordinate digitizer system cannot compete with the fully automatic capability of scanning type digitizers, but it does enable the analyst with his superior interpretation skills to extract image data quickly and then to use the computer for storage of data and rapid reproduction of thematic maps. A possible residual from the coordinate digitizer method is a solution to some of the interpretation problems of the more sophisticated systems. M.M.

A72-11876 * # Crop, soil, and geological mapping from digitized multispectral satellite photography. P. E. Anuta, S. J. Kristof, D. W. Levandowski, T. L. Phillips, and R. B. MacDonald (Purdue University, Lafayette, Ind.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 1983-2016. 7 refs. U.S. Department of Agriculture Contract No. 12-14-100-10292/20; Grant No. NGL-15-005-112.

An experimental study was conducted of digitized multispectral satellite photography to seek answers to the following two questions: what are the data handling problems and requirements of converting photographic density measurements to a usable digital form, and what surface features can be distinguished using multispectral data taken at satellite altitudes. Results include the digitization of three multiband black and white photographs and a color infrared photograph, the conversion of the results of digitization to a useful digital form, and several data analysis experiments. As a whole, they encourage the use of multiband photography as a multispectral data collection instrument. O.H.

A72-11879 # Digital computer mapping of terrain by clustering techniques using color film as a three-band sensor. H. W. Smedes (U.S. Geological Survey, Denver, Colo.), H. J. Linnerud, L. B. Woolaver, and S. J. Hawks (EG & G, Inc., Bedford, Mass.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 2057-2071. 6 refs.

A study to test the feasibility of using the three emulsion layers of color-infrared film as a three-band spectrometer is described. Aerial photography taken of a test site in Yellowstone National Park was scanned on a trichromatic microdensitometer. The trichromatic scanning sampled all three emulsion layers simultaneously, and computer software then converted raw film density readings into analytic film densities, which were analyzed using clustering technique. The clustering analysis produced terrain maps to a scale which overlaid the photography. Using a nine-meter ground resolution, nine terrain classes were mapped with an overall mapping accuracy of better than 85 per cent. (Author)

A72-11880 # Preprocessing of multispectral data and simulation of ERTS data channels to make computer terrain maps of a Yellowstone National Park test site. H. W. Smedes (U.S. Geological Survey, Denver, Colo.), M. M. Spencer, and F. J. Thomson (Michigan, University, Ann Arbor, Mich.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 2073-2089 (3 ff.). 6 refs.

Testing of the possibility of improving the accuracy of classification of areas of a scene by preprocessing the spectral data in multispectral techniques for making terrain maps by computer. Analysis of the training sets shows that the normalized scan-angle function transformation produced better results than those obtained from the best ratio transformation but was more specialized in that it corrected the tendency of the terrain to reflect sunlight to the scanner in different amounts of different angles. Rugged topography could still degrade recognition locally. It is pointed out that preprocessing of the data results in more accurate maps, requires fewer training areas, and makes it possible for much of the area formerly classified as shadow to be classified as to actual terrain type. Use of a simple technique allowed the computer to print the map in color. M.M.

A72-11887 # Experience in the interpretation of the natural formation spectra from manned spacecraft 'Soyuz-7' and 'Soyuz-9'. K. Ia. Kondrat'ev, A. A. Buznikov, O. B. Vasil'ev, B. V. Vinogradov, and A. A. Grigor'ev (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 2273, 2274.

Spectrophotometric measurements of the underlying earth's surface from the manned spacecraft Soyuz-7 and Soyuz-9 show that the variation in spectral brightness of natural surfaces makes it possible to differentiate some types of natural formations with respect to the spectra measured from the spacecraft. As constructed from the data, the special contrast curves on spectral brightnesses of individual natural formations are shown to possess a considerable amount of information on underlying surfaces. O.H.

A72-11892 # Morphological cartography from space photography - Baja California, Mexico. H. G. Gierloff-Emden (München, Universität, Munich, West Germany). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3.

Ann Arbor, University of Michigan, 1971, p. 2343-2348, 2350, 2351.

The application of satellite photographs for making morphological maps is given by an example. The author had mapped the northern area of Baja California (Mexico) in 1961/62 and drawn a morphological map. As is illustrated here, a far better mapping is possible with satellite photographs, more details can be found, and the landscape survey of the satellite photographs makes it possible to recognize interrelations. (Author)

A72-12080 World magnetic survey 1957-1969. Edited by A. J. Zmuda (Johns Hopkins University, Silver Spring, Md.). Paris, International Union of Geodesy and Geophysics (IAGA Bulletin, No. 28), 1971. 211 p.

Land, sea, and airplane earth surveys since 1900, geomagnetic survey by the polar-orbiting geophysical observatory satellites, and results of magnetic surveys of the magnetosphere and adjacent areas by spacecraft are among the subjects discussed in contributions concerned with general information on geomagnetic surveys. Other areas covered include: the origin of the geomagnetic field, magnetic anomalies, the international geomagnetic reference field, and charts. Individual items are abstracted in this issue. M.V.E.

A72-12085 * # Coverage by land, sea, and airplane surveys, 1900-1967. E. Fabiano (U.S. Coast and Geodetic Survey, Rockville, Md.) and S. J. Cain (NASA, Goddard Space Flight Center, Greenbelt, Md.). In: World magnetic survey 1957-1969. Paris, International Union of Geodesy and Geophysics, 1971, p. 94-98.

The worldwide coverage of the earth by land, sea, and aircraft magnetic surveys since the beginning of the 20th century is shown on three world maps for surface surveys spanning the periods of 1900-1930, 1930-1955, and 1955-1967, respectively, on a fourth map for ship-towed magnetometer surveys performed after 1956, and on a fifth map for 1953-1966 airborne survey data. The technique used, involving a position plotting of each measurement with a microfilm plotter, results in the appearance of heavily surveyed regions as completely darkened areas. The coverage includes measurements at about 100,000 land stations, airborne measurements at over 90,000 points, and marine measurements at over 25,000 points. The marine measurements cover over 1,000,000 km of trackline. M.V.E.

A72-12602 Remark concerning the astronomical tying in technique in satellite geodesy (Eine Bemerkung zum astronomischen Anschlussverfahren in der Satellitengeodäsie). H. Lichtenegger. *Zeitschrift für Vermessungswesen*, vol. 96, Nov. 1971, p. 497-500. In German.

The astronomical method of satellite photograph reduction in geodesy is shown to be derivable from the photogrammetric method. The two conditions are found that exist between the eight parameters of the projective relation used in the astronomical method. M.V.E.

A72-14327 # On the triaxiality of the earth on the basis of satellite data. M. Burša (Výzkumný Ústav Geodézie, Prague, Czechoslovakia). *Studia Geophysica et Geodastica*, vol. 15, no. 3-4, 1971, p. 228-240. 34 refs.

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The opinion has been expressed by Heiskanen (1963), Uotila (1963), and Fischer (1963) that triaxiality is a result of the mathematical treatment of data rather than a physical fact. It is shown that this opinion is not in contradiction with the results of satellite observations. However, nonzero values have been definitely obtained for the harmonic coefficients of the second degree and the second order. These data yield a value for the equatorial flattening of about 1/90,000. G.R.

A72-15075 What gravity tells us (Ce que raconte la pesanteur). K. Lambeck and F. Barlier (Paris, Observatoire, Meudon, Hauts-de-Seine, France). *Science Progrès Découverte*, Nov. 1971, p. 24-33. In French.

Consideration of the possibility of using information concerning the earth's gravitational potential to determine the nature of the earth's interior. A geophysical interpretation is given of the anomalies noted in the earth's gravitational field - i.e., the deviations between this field and the reference model. In particular, the role played by the crust and mantle is demonstrated. Methods of determining the earth's gravitational potential with improved accuracy with the aid of satellites and ground observations are described, and the possibility of obtaining a better model of the earth is considered. A.B.K.

A72-15724 Space telemetry by laser stations (Téléométrie spatiale par stations laser). J. Gaignebet (Centre National d'Etudes Spatiales, Groupe de Recherche de Géodésie Spatiale, Brétigny-sur-Orge, Essonne, France) and A. Goebels (Centre National d'Etudes Spatiales, Division Equipements au Sol, France). *La Recherche Spatiale*, vol. 10, Sept.-Oct. 1971, p. 6-9. In French.

Discussion of laser-effect telemetry stations, which consist of transmission and reception groups, a tower, a computer unit, chronometry and data processing circuits, a timekeeper for measurement dating, and related ancillary equipment. By their use it is possible to organize, on an international scale, major geodetic programs which make it possible to determine the shape of the geoid with an accuracy of about 10 m. F.R.L.

A72-15725 An operation of spatial geodesy - The Europe-Africa link (Une opération de géodésie spatiale - La liaison Europe-Afrique). J. J. Levallois. *La Recherche Spatiale*, vol. 10, Sept.-Oct. 1971, p. 9-12. In French.

Discussion of experiments to establish a geodetic link between Europe and Central Africa, i.e., a direct attachment of the stations of Fort Lamy and Dakar to the European system of triangulation. The two-phase operation consists of determination, by laser telemetry, of a base the angles of which are located in Spain, France, and Greece, using the active Geos B geodetic satellite, and the expansion of this base into Africa by spatial triangulation of the passive Pageos satellite. The results obtained from spatial geometry methods have opened both continental and worldwide channels to geodesy. F.R.L.

A72-17429 Current trend in the field of photogrammetry in Japan. T. Maruyasu (Tokyo, University, Tokyo, Japan). In: Photo-optical instrumentation: Present and future developments; Proceedings of the Seminar-in-Depth, Tokyo, Japan, June 25-28, 1970. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1971, p. 43-45.

Description of a technique for representing terrain in the form of three-dimensional coordinates which are stored as digital data in a computer. The construction of a digital terrain model is discussed, as well as the use of a line printer method to calculate the cubic curved surface approximating the terrain, the use of an automatic drafter to draft the vector of the steepest incline of the terrain, and the representation of the terrain surface in the form of grids by the equiangular projection method. A.B.K.

A72-17784 Microwave sensing for earth surface measurements. J. C. Althouse, D. R. Baker, E. P. McClain (NOAA, National Environmental Satellite Service, Washington, D.C.), and H. W. Yates (NOAA, Washington, D.C.). *Instruments and Control Systems*, vol. 45, Jan. 1972, p. 105-107. 14 refs.

Microwave radiometers are passive sensors used to measure the brightness temperature of an object in terms of emitted radiation. Scatterometers are active devices, which transmit energy and measure the reflected or scattered return. These sensors appear to have some potential for hydrologic and oceanographic studies. Microwave radiation is relatively insensitive to clouds, and the possibility also exists of detecting microwaves originating in subsurface layers. Spectral resolution is high, but difficulties will still be encountered with spatial resolution, especially because of constraints on the size of antennas that can be carried on unmanned satellites. The mapping of the areal extent of snow is discussed together with measurements of soil moisture and the determination of surface temperatures. G.R.

A72-17817 # Fundamentals of space geodesy. Part 1 - Geometrical space geodesy (Osnovy kosmicheskoi geodezii. Part 1 - Geometricheskaya kosmicheskaya geodeziya). M. Bursha. Moscow, Izdatel'stvo Nedra, 1971. 129 p. 205 refs. In Russian. (Translation).

A systematic outline is given of geometrical methods and problems of space geodesy and dynamic methods, and the principles of treatment of satellite observations are explained. A detailed analysis is made of the coordinate systems used in space geodesy and of the transformation of these coordinates, and geometrical problems of space geodesy are formulated, giving particular attention to the treatment of synchronous satellite observations and to the relation between individual reference coordinate systems. The Keplerian laws and their dynamic corollaries are derived, and two-body problems involving area and energy integrals are considered, as well as the theory of determining the orbit elements of near satellites. In conclusion, problems of determining the earth's center of mass and creating a worldwide coordinate system and global ellipsoidal parameters are discussed. A.B.K.

A72-18147 Vertical gradients of gravity for areal density contrast exploration. S. Thyssen-Bornemisza and W. R. Jacoby (Department of Energy, Mines and Resources, Ottawa, Canada). *Zeitschrift für Geophysik*, vol. 37, Dec. 1971, p. 735-741. 14 refs.

Making use of an improved technique to measure vertical gradients of gravity in the field the obtained results are analyzed for a possible reliable interpretation. The striking feature of observed gradients is their erratic behaviour caused by strong and short-wavelength surface density variation. Exact interpretation of results is difficult but in special cases additional vertical gradient measurements could provide important information in connection with gravity surveys or even other prospecting methods. (Author)

A72-18259 Altimetry by satellite (Altimétrie par satellites). K. Lambeck (Meudon, Observatoire, Meudon, Hauts-de-Seine, France). *La Recherche Spatiale*, vol. 10, Nov.-Dec. 1971, p. 5-8. In French.

Discussion of the use of radar equipped satellites to make altitude measurements which are useful in geodesy and oceanography. With an altimetric satellite placed in polar orbit the heights of points on the geoid could be obtained over 75 per cent of its surface in a very short time. Such a satellite could also supply information concerning ocean currents, swells and waves, the distribution of atmospheric pressure, and ocean tides beyond the shores. F.R.L.

A72-18261 First evaluation of the ISAGEX operation (Premier bilan de l'opération ISAGEX). G. Brachet. *La Recherche Spatiale*, vol. 10, Nov.-Dec. 1971, p. 13, 14. In French.

Evaluation of thousands of passages of seven satellites observed by laser telemetry and by photography in the course of the ISAGEX (International Satellite Geodetic Experiment) carried out by 13 countries and 54 stations. The main object, to use the accuracy of

laser measurements to improve knowledge of the gravitational field of the earth, is considered to have been obtained. The future planning of the continuing interpretation operation is discussed.

F.R.L.

A72-18330 AS-11A radar program. F. R. Norvelle (U.S. Army, Engineering Topographic Laboratories, Fort Belvoir, Va.). *Photogrammetric Engineering*, vol. 38, Jan. 1972, p. 77-82.

The computer with the AS-11A stereoplotter has been programmed to accommodate the geometry of side-looking radar photographs. The program provides the mathematical model to transform model (or ground) coordinates into corresponding photograph coordinates for conjugate radar presentations. The photo coordinates become electrical signals which, via a servosystem, position the photographs for stereoviewing and, therefore, stereo-compilation of map manuscripts. Relative and absolute orientation procedures have been developed to aid the operator in establishing the radar stereomodel. (Author)

A72-20222 Laser applications in metrology and geodesy. J. C. Owens (Eastman Kodak Research Laboratories, Rochester, N.Y.). In: *Laser applications*. Volume 1. New York, Academic Press, Inc., 1971, p. 61-131. 66 refs.

Alignment applications are considered, giving attention to beam directionality, the use of diffraction, and refraction effects. After alignment, the most straightforward application of lasers involves the measurement of length, using direct optical interferometry for short distances and modulated light for long ones. Basic principles of interferometry are discussed together with interference patterns, aspects of reversible counting, the analysis of outputs, wavelength stabilization, refractive index correction, and three-dimensional applications. Disadvantages of microwave signals can be overcome by using a light beam modulated at the microwave frequency. Velocity measurement applications are also considered, taking into account optical Doppler methods, aspects of scattering by a single particle, the coherent detection of diffuse light, and the effect of focusing.

G.R.

A72-20273 Centering of the '1950 European Datum' with the aid of Doppler measurements of navigation and geodetic satellites (Die Zentrierung des 'Europäischen Datums 1950' mit Hilfe von Doppler Messungen an Navigations- und geodätischen Satelliten). A. Wallenhauer (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Rechenzentrum, Braunschweig, West Germany). *Ortung und Navigation*, no. 1, 1971, p. 57-77. 11 refs. In German. (DFVLR-SONDDR-139)

A procedure for adjusting a local geodetic datum to the center of mass of the earth is proposed which ensures that the positions of the geodetic control stations will have an accuracy sufficient for maritime and flight navigation requirements. The elements of the adjustment are determined by the long-arc method, using Doppler measurements of the Geos 1 and Transit satellites. The elements obtained for the '1950 European Datum' are tabulated. (V.P.)

A72-23278 # Aerial imagery and regionalization. H. Th. Verstappen (International Training Center for Aerial Survey, Delft, Netherlands). In: *Internationale Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 1.* Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 25-45. 28 refs.

The features of multifactor synthesis as a means of regionalization are outlined, placing emphasis on the importance of a thorough analysis of the constituent elements. The selection of regionalization criteria to suit the purpose of the synthesis study is examined. The horizontal and vertical modes of integrating regional surveys are discussed, and the individual factors of importance in regionalization are reviewed. (V.P.)

A72-23297 # A geomorphological reconnaissance of the Central Sahara, using orbital photographs. R. A. Van Zuidam and H. Th. Verstappen (International Training Center for Aerial Survey, Delft, Netherlands). In: *Internationale Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 1.* Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 543-557. 23 refs.

The paper deals with an investigation of the utility of the existing photographic and thermographic images of the arid parts of the Republic of Chad, between Lake Chad and the Tibesti Mountains, where the authors carried out a field survey in October and November 1969. It was found that major structural and volcanic phenomena can be traced on Gemini photographs. Also several features of climatic-geomorphological importance can be indicated, such as former shorelines of Lake Chad, wind-relief of accumulative and corrasive type, and fossil drainage lines. Information useful for geomorphological reconnaissance in arid and semi-arid areas certainly can be obtained from orbiting satellites. (Author)

A72-23312 # Photogrammetry for natural resources surveys. H. G. Jerie (International Training Center for Aerial Survey, Delft, Netherlands). In: *Internationale Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 2.* Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 895-922.

Attempt to define general and subordinate objectives which could govern future activities. Relevant problem areas are analyzed, and existing knowledge and information concerning these areas is compiled and referred to. Subjects and objectives for research and development activities are defined, and proposals are made concerning the strategies to be followed in solving the problems. Ideas for a plan of action for future activities are proposed. (F.R.L.)

A72-28493 # Simultaneous determination of the length and direction of a chord by artificial earth satellite observations (O sovmetnom opredelenii dliny i napravleniia khordy po nabludeniiam ISZ). O. S. Razumov (Tul'skii Politekhnikeskii Institut, Tula, USSR). *Geodeziia i Aerofotos'emka*, no. 3, 1971, p. 43-47. 6 refs. In Russian.

Description of a procedure for treatment of observational data in the determination of the length and direction of the path of a vector linking some sites of geodetic observations in Arctic and Antarctic regions. The procedure is designed to facilitate data processing for synchronous spacecraft observations by optical and laser techniques in connection with a program for plotting a geodetic vector. (V.Z.)

A72-29633 # Precision of small-scale aerial photograph photo-transformation from contour points on outdated photomaps (O tochnosti fototransformirovaniia melkomashtabnykh aerosnimkov po konturnym tochkam starykh fotoplanov). A. V. Gvozdev. *Geodeziia i Kartografiia*, Feb. 1972, p. 44-48. In Russian.

Theory and technique are given for larger-scale map plotting from contour points of outdated smaller-scale aerial survey photographs. The accuracy of this transformation process is evaluated. The mean square errors are given for 1:10,000 maps prepared from 1:40,000 aerial photographs. (V.Z.)

A72-31247 # Recent developments in the technique of cartographic and environmental surveys made by artificial satellites and by other spatial means (Recenti sviluppi della tecnica dei rilievi cartografici e ambientali eseguiti da satelliti artificiali e da altri mezzi spaziali). G. Birardi (Istituto Geografico Militare, Florence, Italy). In: *Space activity in the field of ecology and earth resources; International Convention on Space, 12th, Rome, Italy, March 23-25, 1972, Proceedings.* Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1972, p. 343, 345-357. In Italian.

Synthesis of the present state of development of investigations of the environment and earth resources with the aid of satellites and orbiting platforms. The use of panoramic cameras, mapping camera systems, and the laser altimeter in mapping from earth satellites is discussed, and the operation of the Skylab A and B orbiting stations is described. The possibility of thematic mapping with the aid of satellites is considered, and the characteristics and equipment of the ERTS A satellite which make it suitable for such mapping are noted.

A.B.K.

A72-31929 # Stellar triangulation measured with balloon-borne beacons - Its scale and position. T. J. Kukkamaki (Finnish Geodetic Institute, Helsinki, Finland). *COSPAR, Plenary Meeting, 15th, Madrid, Spain, May 10-24, 1972, Paper. 9 p.*

A general account is given of the measurement of the stellar triangulation net of Finland with sides 200 km in length. The balloon-borne beacon is described in more detail. The scale of the net will be determined with the aid of a precision traverse measured with a laser-geodimeter. The position of the net will be determined through observation of passive satellites on both ends of the precision traverse. Here a time micrometer with no moving part is used and it is described in detail.

(Author)

A72-31995 # Experimental verification of proposed Skylab altimeter measurements. B. S. Yapple, A. Shapiro, E. A. Uliana, D. L. Hammond, and K. J. Craig (U.S. Navy, E. O. Hulburt Center for Space Research, Washington, D.C.). *COSPAR, Plenary Meeting, 15th, Madrid, Spain, May 10-24, 1972, Paper. 15 p.*

The S-193 experiment in Skylab 1 includes a radar altimeter for the remote sensing of the earth's surface features. The expected performance of the altimeter will permit the resolution of ocean wave heights and the profiling of the mean sea surface. In order to evaluate the potential capability of the Skylab altimeter as a height sensor, a series of experiments have been conducted using nano-second radars on tower and aircraft platforms to simulate the satellite altimeter performance. The results of preliminary measurements indicate that the Skylab altimeter, assuming no additional instrumental range noise, should be able to measure geoidal and oceanographic height variations of the order of 10 cm over 10 km paths.

(Author)

A72-33799 # Spatial transformation in certain problems of satellite geodesy (Transformacja przestrzenna w pewnych zadaniach geodezji satelitarnej). A. Czarnecki. *Geodezja i Kartografia*, vol. 21, no. 2, 1972, p. 79-90. 11 refs. In Polish.

Certain properties of orthogonal transformations which are relevant for continental-scale geodetic grids are examined in connection with the use of satellite methods for tying-in large geodetic grids. A numerical example based on fictitious data illustrates. (1) scale alteration in the geodetic grid, (2) determination of Euler angles specifying the tilt of the network, and (3) joint determination of scales, inclinations, and displacements of geodetic grids.

T.M.

A72-35336 Transformation of points from sidelooking radar images into the map system. E. R. Bosman, E. Clerici, D. Eckhart, and K. Kubik. *Bildmessung und Luftbildwesen*, vol. 40, July 1, 1972, p. 183-188.

Side Looking Airborne Radar (SLAR) has become a valuable tool in the remote sensing of the earth's resources because of its unique characteristics. Certain problems regarding the employment of SLAR are connected with inherent geometric image deformations. A research project was started with the objective to find an approach for correcting these image distortions and to develop a program system for transforming features from SLAR images for a map representation. A method consisting of two stages is discussed. The stages include a preliminary transformation and an approximate complementary transformation. Details of the program system are considered together with some numerical results obtained in tests conducted with the new program system.

G.R.

A72-36321 Spacecraft, photomorphic units and regional analysis. T. J. Flynn, Jr. and R. W. Peplies (East Tennessee State University, Johnson City, Tenn.). In: *Scanning the spectrum: Proceedings of the Tenth Annual Region 3 Convention*, Knoxville, Tenn., April 10-12, 1972. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. M6-1 to M6-4. 6 refs.

This paper is concerned with describing the background methodology and philosophy, and preliminary techniques for delimiting large, regional areas called photomorphic units. Photomorphic units are defined as areas of similar tone/color, texture, and pattern characteristics associated with hyper-altitude and spacecraft remote sensing returns. These patterns may provide a useful tool for defining regions for academic and planning purposes.

(Author)

A72-36491 # Coherent optical terrain-relief determination using a matched filter. S. J. Krulikoski, Jr. and R. B. Forrest (Bendix Information Sciences Laboratory, Southfield, Mich.). *Bendix Technical Journal*, vol. 5, Spring 1972, p. 11-18. 6 refs.

Coherent optical processing techniques show considerable promise for the extremely rapid extraction and recording of terrain-elevation data. A system for collecting such data has been conceived, which is centered around an image/matched-filter coherent optical processor. This paper discusses the principle of image/matched-filter correlation and some factors that must be considered in incorporating it into operational equipment.

(Author)

A72-37609 Holography in photogrammetry and mapping. D. O'Connor (U.S. Army, Washington, D.C.). In: *Engineering applications of holography: Proceedings of the Symposium*, Los Angeles, Calif., February 16, 17, 1972. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1972, p. 103-112. 13 refs.

This paper gives a broad overview of the photogrammetric mapping process with a view to suggesting possible areas for research in the mensuration of holograms and a range of topographic data handling problems from data acquisition through storage, retrieval, and display. The overview is given against a background of research results in the mensuration of holograms and their shape deformations. Contour maps of laboratory objects are included. Also shown is a contour map of terrain, prepared from a synthesized hologram based on a stereopair of overlapping aerial photographs.

(Author)

A72-39738 Aerotriangulation by SAPGO. K. W. Wong and G. Elphinstone (Illinois, University, Urbana, Ill.). *Photogrammetric Engineering*, vol. 38, Aug. 1972, p. 779-790. 8 refs. Research supported by the University of Illinois and U.S. Army.

A mathematical solution has been developed to include geodetic measurements in a simultaneous solution for aerotriangulation. In addition to the conventional photogrammetric measurements such as photo coordinates and auxiliary data, the solution is capable of incorporating into the adjustment such geodetic measurements as distances, horizontal angles, Laplace azimuths, elevation differences, longitudes, latitudes and elevations. This solution, code-named SAPGO, has been coded in Fortran IV computer language and has been tested with fictitious data in both strips and blocks.

(Author)

A72-40494 # Fundamental geodetic parameters of the earth's figure and the structure of the earth's gravity field derived from satellite data. M. Bursa (Vyzkumny Ustav Geodezie, Prague, Czechoslovakia). (*International Union of Geodesy and Geophysics, General Assembly, 15th, Moscow, USSR, July 30-Aug. 14, 1971.*) *Studia Geophysica et Geodastica*, vol. 16, no. 1, 1972, p. 10-29. 19 refs.

A72-42025 # Stereophotogrammetric processing methods for photographs made from a mobile basis (Sposoby stereofotogrammetricheskoi obrabotki snimkov, poluchennykh s podvizhnogo bazisa). Iu. S. Tiufin. Moscow, Izdatel'stvo Nedra, 1971. 169 p. 131 refs. In Russian.

Theoretical foundations and techniques are set forth for stereophotogrammetry of pictures taken from moving camera carriers. Mutual orientation of individual frames in horizontal surveys, absolute orientation of geometric photographic models, the accuracy of stereophotogrammetric processes, and the construction of photogrammetric networks are among the principal topics. Also covered are the application of the method of least squares in analytical photogrammetry, opticommercial photogrammetric processing methods, geodetic orientation with respect to independent geometrical models, and computer applications in stereophotogrammetry. Discussed specifically are stereophotographic surveys of coastal areas, sea surface roughness studies by stereophotogrammetry from aircraft, and outer space studies. V.Z.

A72-43366 # Description of the earth's main magnetic field (Opisanie glavnogo magnitnogo polia zemli). L. O. Tiurmina (Akademiia Nauk SSSR, Institut Zemnogo Magnetizma. Ionosfery i Rasprostraneniia Radiovoln, Krasnaya Pakhra, USSR). (Vsesoiuznaia Konferentsiia po Postoiannomu Geomagnitnomu Poliu i Paleomagnetizmu, Kiev, Ukrainian SSR, Dec. 1970.) *Geomagnetizm i Aeronomiia*, vol. 12, July-Aug. 1972, p. 676-687. 15 refs. In Russian.

Review of a number of methods of describing the earth's main magnetic field. The cartographic method of describing the main magnetic field is discussed, as well as analytical methods based on dipole representations or on representations by a Gaussian (or spherical harmonic) series. A number of methods of representing the coefficients of a spherical harmonic series are discussed, including the method of least squares (the most widespread), the orthogonalization method, and a modification of integral methods based on the use of the orthogonality property of spherical harmonics. The results of an application of this latter method to an analysis of the 1965 epoch geomagnetic field are cited. An iterative method is also described and is applied in an analysis of OGO 2, OGO 4, OGO 6, and Cosmos 49 satellite data. A.B.K.

A72-45228 # A system of help to geodesy - The Géole project (Un système d'aide à la géodésie - Le projet Géole). D. Thieriet (Centre National d'Études Spatiales, Paris, France). *International Astronautical Federation, International Astronautical Congress, 23rd, Vienna, Austria, Oct. 8-15, 1972, Paper. 18 p.* In French.

The Géole project makes use of ground beacons interrogated by a satellite, the major objectives being the exact location of fixed isolated points or of slightly mobile points. The Géole system comprises one or more identical satellites, trajectographic and tracking beacons, telemetry-telecontrol stations, and an operations and computing center. The satellite plays the double role of tracking and information transfer. The system can carry out geometric, dynamic, and geodynamic studies. The procedures for carrying out the program are described. F.R.L.

A72-45399 # Space research 1970: Investigation of the gravitational fields and shapes of the earth, other planets, and the moon on the basis of spacecraft observations (Issledovanie kosmicheskogo prostranstva 1970: Issledovanie gravitatsionnykh polei i formy zemli, drugih planet i luny po nabludeniiam kosmicheskikh apparatov). L. P. Pellinen. Moscow, Izdatel'stvo VINITI, 1972. 181 p. 769 refs. In Russian.

The elements of the theory of motion of artificial earth satellites and space vehicles in the gravitational fields of the earth and other planets are outlined. The principles of determining the parameters of these fields from perturbations of satellite orbits are examined, and optical, laser, and electronic methods of satellite observation are discussed. Methods of determining the surface reliefs of planets and the coordinates of reference grids are described. V.P.

A73-10405 * Precision geodesy via radio interferometry. H. F. Hinteregger, I. I. Chapiro, D. S. Robertson, C. A. Knight, R. A. Ergas, A. R. Whitney, B. F. Burke (MIT, Cambridge, Mass.), A. E. E. Rogers (Haystack Observatory, Westford, Mass.), J. M. Moran (Smithsonian Astrophysical Observatory, Cambridge, Mass.), and T. A. Clark (NASA, Goddard Space Flight Center, Greenbelt, Md.). *Science*, vol. 178, Oct. 27, 1972, p. 396-398. 16 refs. ARPA-supported research; NSF Grant No. GP-25865; Grant No. NGR-22-174-003; Contract No. NAS9-7830.

Very-long-baseline interferometry experiments, involving observations of extragalactic radio sources, were performed in 1969 to determine the vector separations between antenna sites in Massachusetts and West Virginia. The 845.130-kilometer baseline was estimated from two separate experiments. The results agreed with each other to within 2 meters in all three components and with a special geodetic survey to within 2 meters in length; the differences in baseline direction as determined by the survey and by interferometry corresponded to discrepancies of about 5 meters. The experiments also yielded positions for nine extragalactic radio sources and allowed the hydrogen maser clocks at the two sites to be synchronized. (Author)

A73-11850 Side-look radar provides a new tool for topographic and geological surveys. R. E. Powers (Westinghouse Defense and Electronic Systems Center, Baltimore, Md.). *Westinghouse Engineers*, vol. 32, Nov. 1972, p. 176-181.

Discussion of the efficiency of a side-look radar applications in earth resources surveys and geological reconnaissance. The high-quality imagery of side-look radar systems is demonstrated on a New Guinea area survey which provided clearly visible geological features covered by a dense jungle. The side-look radar is characterized as an active system operable day and night over clear or cloud-covered terrains, whose performance is superior to that of IR scanners, radiometers, or scatterometers in earth resources surveys. V.Z.

A73-12168 # A method of a determination of earth's motions around its mass center from simultaneous laser and photographic observations of artificial earth satellites made by two stations. B. Kolaczek (Warszawa, Politechnika, Warsaw, Poland). *Artificial Satellites*, vol. 7, Sept. 1972, p. 13-15.

A73-14776 The use of artificial satellites for geodesy; Proceedings of the Third International Symposium, Washington, D.C., April 15-17, 1971. Symposium sponsored by the American Geophysical Union, American Institute of Aeronautics and Astronautics, National Oceanic and Atmospheric Administration, and U.S. Army. Edited by S. W. Henriksen, A. Mancini, and B. H. Chovitz. Washington, D.C., American Geophysical Union (Geophysical Monograph Series, No. 15), 1972. 293 p. \$28.

The papers deal with terrestrial geodesy and geodesy on the moon and other planets, and represent work done with either artificial or natural satellites. Attention is given to theory and results of geometric and physical geodesy. Instrumentation, environmental factors, extraterrestrial geodesy, and data management are discussed. F.R.L.

A73-14781 Geometrical adjustment with simultaneous laser and photographic observations on the European datum. A. Cazenave, O. Dargnies, G. Balmino, and M. Lefebvre (Groupe de Recherches de Géodésie Spatiale, Brétigny-sur-Orge, Essonne, France). In: The use of artificial satellites for geodesy; Proceedings of the Third International Symposium, Washington, D.C., April 15-17, 1971.

Washington, D.C., American Geophysical Union, 1972, p. 43-48. 6 refs. Research supported by the Centre National de la Recherche Scientifique, Direction des Recherches et Moyens d'Essais, and Centre National d'Études Spatiales.

During the 1968 European geodetic observing program organized jointly by the Centre National d'Études Spatiales, France, and the Smithsonian Astrophysical Observatory, United States, a

large number of simultaneous or quasi-simultaneous laser and optical observations were collected. Particular attention has been given to the interpolation necessary to make observations exactly simultaneous. More than 2000 independent relations have thus been obtained, linking 9 station positions. The resulting relative coordinates of these stations are compared with other determinations.

(Author)

A73-14783 * **Geos 1 Secor observations in the Pacific /Solution SP 7/.** I. I. Mueller, J. P. Reilly, C. R. Schwarz, and G. Blaha (Ohio State University, Columbus, Ohio). In: The use of artificial satellites for geodesy; Proceedings of the Third International Symposium, Washington, D.C., April 15-17, 1971. Washington, D.C., American Geophysical Union, 1972, p. 59-65. 7 refs. Grant No. NGL-36-008-093.

Secor observations have defined a geodetic network extending through the Pacific Ocean from Japan, with three stations on the Japanese datum, to the west coast of the United States. Thus this network was connected to major datums on both ends. However, observations on Geos 1 were taken only in the middle of the network, from Truk Island to Maui, so that the network determined by Geos 1 observations alone is not directly attached to any major geodetic datum. A little-known procedure called 'inner adjustment' was found to be the appropriate method to define a coordinate system for the adjustment of the isolated network and to determine the inner consistency of the observations. The network was indirectly tied to the North American datum by the use of (1) satellite observing stations of other observing systems whose coordinates were previously determined, (2) relative positions of these and nearby Secor stations, as determined by local surveys, and (3) geodetic heights composed of leveled (orthometric) heights plus geoid heights obtained from a geoid map.

(Author)

A73-14786 **Survey improvement and calibration analysis for the Air Force Eastern Test Range with Geos C.** N. Bush (Pan American World Airways, Inc., Patrick AFB, Fla.). In: The use of artificial satellites for geodesy; Proceedings of the Third International Symposium, Washington, D.C., April 15-17, 1971. Washington, D.C., American Geophysical Union, 1972, p. 83-91. 9 refs.

The results of an error analysis utilizing Geos C are presented with respect to geodetic improvement at the Air Force Eastern Test Range as well as at the Space and Missile Technical Evaluation Center. Radars were the only data source considered for the study, and data were taken from Kwajalein to Ascension. The geodetic error analysis results from a short-arc analysis are developed in terms of Cape Kennedy being the known reference station for data from Ascension to Cape Kennedy, while Vandenberg Air Force Base is the known reference station for the data from Kwajalein to the U.S. mainland. The results show that the relative survey improvement of Ascension to the Cape, as well as the relative survey improvement of Kwajalein, Johnston Island, and Hawaii to Vandenberg Air Force Base, can be obtained to 17 meters or better.

(Author)

A73-14788 **Nature of the satellite-determined gravity anomalies.** M. A. Khan (Hawaii University, Honolulu, Hawaii). In: The use of artificial satellites for geodesy; Proceedings of the Third International Symposium, Washington, D.C., April 15-17, 1971. Washington, D.C., American Geophysical Union, 1972, p. 99-106. 6 refs.

A mathematical model of isostatic anomaly potential of the earth is presented. These anomalies must provide an accurate index of subsurface anomalous mass distribution in the earth. It is demonstrated that the isostatic reduction is not critical for low-degree spherical harmonic solutions of satellite-determined geopotential. The correction does become important, however, for higher-degree harmonic solutions of geopotential, more so for those derived from low-altitude orbits.

(Author)

A73-14789 **Simple layer model of the geopotential in satellite geodesy.** K.-R. Koch (Bonn, Universität, Bonn, West Germany). In: The use of artificial satellites for geodesy; Proceedings of the Third International Symposium, Washington, D.C., April 15-17, 1971. Washington, D.C., American Geophysical Union, 1972, p. 107-109. 13 refs.

Review of a method of satellite geodesy representing the earth's gravity field by the potential of a simple layer. This geopotential model has been applied to optical satellite observations and Doppler data. It is compared with different representations of the gravity field.

M.V.E.

A73-14791 **Representation of the earth potential by buried masses.** G. Balmino (Meudon, Observatoire, Meudon, Hauts-de-Seine, France). In: The use of artificial satellites for geodesy; Proceedings of the Third International Symposium, Washington, D.C., April 15-17, 1971. Washington, D.C., American Geophysical Union, 1972, p. 121-124.

Some ways of representing the earth potential by point masses are explored. The 1969 standard earth model of the Smithsonian Astrophysical Observatory is used as a reference. Points regularly distributed on a sphere inside the earth have been considered, as well as nonuniform configurations. The values of the masses are derived by a least-squares fit to the SAO field. The values of the different representations obtained have been checked by computing the geoid heights, gravity anomalies, and spherical harmonics associated with the field of the masses. The best model obtained consists of 126 points, mostly at a depth of 1300 km, tied to the important gravity anomalies derived from the reference field. The mean of the residuals is 6 mgal.

(Author)

A73-14792 * **Geopotential representation with sampling functions.** C. A. Lundquist (Smithsonian Astrophysical Observatory, Cambridge, Mass.) and G. E. O. Giacaglia. In: The use of artificial satellites for geodesy; Proceedings of the Third International Symposium, Washington, D.C., April 15-17, 1971. Washington, D.C., American Geophysical Union, 1972, p. 125-131. 19 refs. Grant No. NGR-09-015-002; Contract No. N00014-67-A-0126-0013.

Satellite-to-ocean altitudes measured to meter accuracy eventually can yield a geoid representation with significant short-wavelength structure over ocean areas. To cope conveniently with this expected detail, one suggested analytical technique would represent the geopotential or the geoid as an expansion in sampling functions that are linear combinations of spherical harmonics. Each of the sampling functions makes its principal contribution to the geopotential in a single geographical region. For a representation truncated after degree N, there are (N + 1) squared such functions associated with a like number of points distributed nearly regularly on the globe. The features of this geopotential representation can be illustrated by considering the case N = 22, for which an expansion in sampling functions can be produced that is equivalent to the geopotential of the 1969 Smithsonian standard earth.

(Author)

A73-14798 * **Detailed gravimetric geoid for the United States.** W. E. Strange, S. F. Vincent, R. H. Berry (Computer Sciences Corp., Falls Church, Va.), and J. G. Marsh (NASA, Goddard Space Flight Center, Greenbelt, Md.). In: The use of artificial satellites for geodesy; Proceedings of the Third International Symposium, Washington, D.C., April 15-17, 1971. Washington, D.C., American Geophysical Union, 1972, p. 169-176. 11 refs.

A detailed gravimetric geoid was computed for the United States using a combination of satellite-derived spherical harmonic coefficients and 1 by 1 deg mean gravity values from surface gravimetry. Comparisons of this geoid with astrogeodetic geoid data indicate that a precision of plus or minus 2 meters has been obtained. Translations only were used to convert the NAD astrogeodetic geoid heights to geocentric astrogeodetic heights. On the basis of the agreement between the geocentric astrogeodetic geoid heights and the gravi-

metric geoid heights, no evidence is found for rotation in the North American datum. The value of the zero-order undulation can vary by 10 to 20 meters, depending on which investigator's station positions are used to establish it. (Author)

A73-14803 * Rapid global geoid mapping with satellite altimetry. H. R. Stanley (NASA, Wallops Station, Wallops Island, Va.), N. A. Roy (Wolf Research and Development Corp., Pocomoke City, Md.), and C. F. Martin (Wolf Research and Development Corp., Riverdale, Md.). In: The use of artificial satellites for geodesy; Proceedings of the Third International Symposium, Washington, D.C., April 15-17, 1971. Washington, D.C., American Geophysical Union, 1972, p. 209-216.

Theoretical demonstration of the feasibility to build, fly, calibrate, and evaluate an orbiting altimeter system that is to offer the basis for accurate geoidal mapping on a global scale. The problems involved in instrumentation and orbit determination are discussed. Following a description of the Skylab altimeter characteristics, a more advanced design is postulated. This new design is shown to be capable of an accuracy of better than 50 cm and noise levels of 20 cm. With proper premission analysis and careful scheduling, a global geoidal map of 1- to 2-meter resolution can be obtained within an 18- to 20-day period by using a high-inclination orbit. M.V.E.

A73-14806 Geodesy with orbiting gravity gradiometers. R. L. Forward (Hughes Research Laboratories, Malibu, Calif.). In: The use of artificial satellites for geodesy; Proceedings of the Third International Symposium, Washington, D.C., April 15-17, 1971. Washington, D.C., American Geophysical Union, 1972, p. 239-243. 6 refs.

A new instrument for sensing the earth's gravity field, the rotating gravity gradiometer, has been demonstrated in the laboratory. A design with sensitivity adequate for geodesy from low earth orbit is under development by NASA. The gravity gradiometer measures the gradient of the gravity force field rather than the field itself. The sensor does not respond to acceleration and can operate in free fall or in accelerating environments where the usual gravity meters cannot work. A gradiometer in a spin-stabilized satellite in a low polar orbit will make a significant contribution to the geodetic mapping program presently being carried out by satellite tracking, since it preferentially senses the higher harmonics (greater than 35) of the earth's field, where the Doppler tracking signals fall off rapidly. (Author)

A73-14807 Timing for geodetic satellites. W. Markowitz (Marquette University, Milwaukee, Wis.). In: The use of artificial satellites for geodesy; Proceedings of the Third International Symposium, Washington, D.C., April 15-17, 1971. Washington, D.C., American Geophysical Union, 1972, p. 245, 246.

Review of the timing accuracies obtainable in the concurrent observation of geodetic satellites by means of high precision techniques in current use and under development. Available accuracies are 1 to 20 microsec with Loran C and 0.1 to 1.0 microsec with portable atomic clocks. Higher accuracies may be developed with very-long-baseline interferometry. M.V.E.

A73-15403 Topographic earth observations using radar techniques with a single flight. G. E. Carlson (Missouri, University, Rolla, Mo.). In: NTC '72; National Telecommunications Conference, Houston, Tex., December 4-6, 1972, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 14D-1 to 14D-6.

A new technique for obtaining stereo radar image pairs on a single flight is discussed. These image pairs can be used in a stereo comparator to generate topographic maps. The technique has the following advantages: (1) it requires only a single flight, (2) radar illumination is from very nearly the same angle and, (3) radar illumination is from very nearly the same range. The last two

advantages enhance the photointerpretability and stereoscopic viewability of the resulting image pairs. Analytic results are shown which verify the capabilities of the technique. (Author)

A73-17192 Accurate localization by the Geole Project satellite (Localisation précise par satellite Projet Géole). D. Thieriet (Centre National d'Etudes Spatiales, Brétigny-sur-Orge, Essonne, France). *L'Aéronautique et l'Astronautique*, no. 37, 1972, p. 43-53. In French.

Review of some of the problems raised by space activities devoted to earth surface observations for various specific purposes, and description of the main features of the French geodetic Geole-Project satellite. Following a definition of the localization accuracy and speed requirements of oil-prospecting, geodetic, cartographic, topographic, and glaciological tasks, as well as of their respective occurrence frequency, the desirable features of geostationary and nongeostationary satellite systems for the performance of such tasks are considered, and the system selected for the Geole Project is described in terms of its underlying principle, orbit, chosen frequency bands and signals, antennas, and performance capabilities. M.V.E.

A73-22192 Residual geomagnetic field from the satellite Cosmos 49. N. P. Benkova, Sh. Sh. Dolginov, and T. N. Simonenko (Akademiia Nauk SSSR, Institut Zemnogo Magnetizma, Ionosfery i Rasprostraneniia Radiovoln, Akademgorodok, USSR). *Journal of Geophysical Research*, vol. 78, Feb. 10, 1973, p. 798-803. 9 refs.

The residual field from Cosmos 49 is presented in chart form. This map displays vast areas (1000 to 4000 km across) of negative and positive Delta T (the T are differences between measured and model fields) that are of the order of a few tens of gammas. The external field does not exert any essential influence on the Delta T distribution. The frequency spectrum of Delta T is similar to that of the model field used for the greater part of the chart, but within the 'contrast zones' the Delta T spectrum contains higher harmonics. There is no apparent correlation between the Delta T distribution and near-surface anomalies or the thickness of the magnetoactive layer of the earth's crust. The correlation with heat flow distribution particle density distribution. These calculated data are compared with those of the PN whistler observations obtained from the Alouette-2 data. M.V.E.

A73-24483 # Analytical transformation of photographs for plotting topographic and photogrammetric maps in prescribed projections (Analiticheskoe transformirovanie snimkov dlia sostavleniia topograficheskikh kart i fotokart v zadannoi proektii). A. N. Lobanov and I. G. Zhurkin (Moskovskii Institut Inzhenerov Geodezii, Aerofotos'emki i Kartografii, Moscow, USSR). *Geodeziia i Aerofotos'emka*, no. 5, 1972, p. 79-88. 5 refs. In Russian.

A theoretical basis is discussed for a carry-over of points from aerial photographs onto maps to be plotted in prescribed projections. Formulas are derived for the point translation process involved. Recommendations are given for a more effective execution of the translation under various aerial survey conditions. The usefulness of this technique in automated aerial map production is indicated. V.Z.

A73-26294 # Determination of the relative position of points on the earth surface with the aid of satellite observations (Opredelenie vzaimnogo polozheniia tochek zemnoi poverkhnosti pri pomoshchi nabludenii iskusstvennykh sputnikov zemli). V. K. Khristov. *B'lgarska Akademiia na Naukite, Tsentralna Laboratoriia po Geodeziia, Izvestiia*, no. 13, 1972, p. 31-46. In Russian.

A73-26631 Radar altimeter optimization for geodesy over the sea. R. O. Harger (Maryland, University, College Park, Md.). *IEEE Transactions on Aerospace and Electronic Systems*, vol. AES-8, Nov. 1972, p. 728-742. 17 refs.

The optimum processor and its accuracy limit for radar altimetry for geodetic use over the sea are studied with a model

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accounting for random surface reflectivity, sea height variation, additive noise, and pointing errors, and allowing for arbitrary antenna patterns, signal modulations, and other system parameters.

A73-27359 # Analytical model of a geomagnetic survey from the Cosmos-321 artificial earth satellite (Analiticheskaya model' geomagnitnoi s'etmki s ISZ 'Kosmos-321'). Sh. Sh. Dolginov, N. A. Zhuravleva, A. N. Pushkov, L. O. Tiurmina, and T. N. Cherevko (Akademiya Nauk SSSR, Institut Zemnogo Magnetizma, Ionosfery i Rasprostraneniya Radiovoln, Krasnaya Pakhra, USSR). *Geomagnetizm i Aeronomiya*, vol. 13, Jan.-Feb. 1973, p. 196, 197. In Russian.

Geomagnetic measurements taken by the cesium magnetometer of Cosmos-321 in about 12,000 points of its path at intervals of 20 sec are used to construct an analytical model of a geomagnetic survey made by an earth satellite. Two sampling data series are combined to obtain a geomagnetic field model. V.Z.

A73-27691 Spatial geodesy (La géodésie spatiale). J. Kovalevsky (Groupe de Recherche de Géodésie Spatiale, Brétigny-sur-Orge, Essonne, France). *La Recherche*, vol. 4, Apr. 1973, p. 339-346, 7 refs. In French.

The surface of the oceans conforms exactly with an 'equipotential surface,' and is called the geoid, conventionally representing the shape of the earth. In practice, the geoid is nearly an ellipsoid. Thanks to satellites, old geodetic systems can be linked up. By using satellites at sufficient altitude, it is possible to connect stations separated by the oceans, and to construct a genuine world-wide geodetic system. Intensive use of lasers should make it possible to achieve very high accuracy in measurement of the geoid. F.R.L.

A73-28006 # Geodesy and space (Geodeziya i kosmos). L. P. Pellinen (Tsentral'nyi Nauchno-Issledovatel'skii Institut Geodezii, Aerofotos'emki i Kartografi, Moscow, USSR). *Geodeziya i Aerofotos'emka*, no. 6, 1972, p. 31-38, 18 refs. In Russian.

The advances of satellite-related geodetic techniques since the first artificial satellite of 1957 are reviewed, covering the uses of photography, radar and laser in satellite observations with geodetic applications. General considerations are given concerning the future prospects of space geodesy. V.Z.

A73-28007 # Advancement of gravimetry and of the theory of the earth's figure (Razvitiye gravimetrii i teorii figury zemli). P. F. Shokin and B. P. Shimbirev (Moskovskii Institut Inzhenerov Geodezii, Aerofotos'emki i Kartografi, Moscow, USSR). *Geodeziya i Aerofotos'emka*, no. 6, 1972, p. 49-57, 8 refs. In Russian.

The progress of work in force of gravity measurements during the last fifty years is reviewed, including the latest satellite applications. Emphasis is made on Soviet studies and devices in the field of gravimetry and satellite photography. V.Z.

A73-28008 # Photographic experiments during a spacecraft flight lasting a number of days (Fotograficheskie eksperimenty pri mnogosutochnom polete kosmicheskogo korablia). V. I. Sevast'yanov. *Geodeziya i Aerofotos'emka*, no. 6, 1972, p. 69-71. In Russian.

Brief review of photographic experiments carried out on the Soluz-9 spacecraft during its 18-days in orbit. Earth's atmosphere brightness photographs, showing the brightness gradients of water bodies, snow area and other features, were taken on cameras with focal lengths of 30, 90 and 300 mm and objective aperture ratios from 2.8 to 6.8. V.Z.

A73-28150 # Photographic satellite observations with the Automatic Camera for Astrogeodesy. K.-H. Marek (Deutsche Akademie der Wissenschaften, Zentralinstitut für Geophysik, Potsdam, East Germany). *Jena Review*, vol. 17, no. 7, 1972, p. 340-344, 12 refs.

A73-28170 Mapping of mangrove and perpendicular-oriented shell reefs in southeastern Panama with side-looking radar. A. J. Lewis (Louisiana State University, Baton Rouge, La.) and H. C. MacDonald (Arkansas, University, Fayetteville, Ark.). *Photo-*

A73-28320 # Determination of the length and direction of a chord from observations of an artificial satellite. O. S. Razumov (Tul'skii Politehnicheskii Institut, Tula, USSR). (*Geodeziya i Aerofotos'emka*, no. 3, 1971, p. 43-47.) *Geodesy and Aerophotography*, no. 3, 1971, p. 132-134, 5 refs. Translation.

A73-29416 # Use of a computer to design surveys made by the stereotopographic method (Ispol'zovanie EVM dlia proektirovaniya s'emok, vypolniamykh stereotopograficheskimi metodami). A. G. Vanin. *Geodeziya i Kartografiya*, Feb. 1973, p. 43-50. In Russian.

Mathematical description of the technical designing of topographic surveys in scales from 1:25,000 to 1:2000 with the aid of a computer. The proposed program includes five interacting units and makes it possible to calculate the aerial photography parameters, the length of the photogrammetric networks, the volume of the geodetic surveying base, and the labor and monetary expenditures according to a number of technological variants and to select the optimal technical design variant. The calculations made according to the proposed program show the possibility of reducing expenditures by selecting the optimal variant; in so doing, the design time is reduced severalfold. A.B.K.

A73-33362 Cartographic applications of high-altitude aircraft photographs. A. P. Colvocoresses (U.S. Geological Survey, Washington, D.C.). In: Operational remote sensing: Proceedings of the Seminar, Houston, Tex., February 1-4, 1972. Falls Church, Va., American Society of Photogrammetry, 1972, p. 162-170.

During the past three years NASA and the USAF have been flying RB-57 and U-2 aircraft at altitudes from 60,000 to 70,000 ft. Among the sensors used, mapping cameras of 6- and 12-in. focal length have been predominant, and the films used include panchromatic, color, and color infrared. The conversion of the resulting photographs into useful cartographic products is discussed. Attention is given to orthophotoquads, color photomaps, and thematic mapping. F.R.L.

A73-34049 Determination of the orientation angles of aerial photographs from the horizon. G. D. Fedoruk (Moskovskii Institut Inzhenerov Geodezii, Aerofotos'emki i Kartografi, Moscow, USSR). (*Geodeziya i Aerofotos'emka*, no. 5, 1971, p. 77-82.) *Geodesy and Aerophotography*, no. 5, 1971, p. 264-266. Translation.

A method is described for determining the angles of slope with respect to the photographed surface in the angular external orientation of photographs on which the visible horizon line is to be seen. Several versions of the problem are examined, and the respective formulas are derived. V.P.

A73-35932 # Satellite geodesy and the internal structure of the earth /Results of space research and the International Geodynamical Programme/. G. Barta (Eotvos Lorand Tudományegyetem, Budapest, Hungary). *COSPAR, Planetary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper. 20 p.*

It is shown that from a geoid composed of two rotation-symmetrical shapes, as obtained by methods of satellite geodesy, it may be inferred that the earth's core has an asymmetric structure and that there exists a relationship between the gravity fields and magnetic fields of the earth. The magnetic secular variation is in correspondence with a large scale mass motion. This motion may produce also a change in the earth's figure and in the gravity field. V.P.

A73-36019 # The cartographic and scientific application of ERTS-1 imagery in polar regions. R. B. Southard and W. R. MacDonald (U.S. Geological Survey, Topographic Div., Washington, D.C.). *COSPAR, Plenary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper.22* p. 6 refs.

The first Earth Resources Technology Satellite (ERTS-1) is providing valuable data for investigation of the Arctic and Antarctic. The feasibility and economy of using ERTS imagery is being investigated for compiling maps of unmapped areas at scales of 1:250,000 to 1:1,000,000, for supplementing planimetric information such as crevasse fields and glacier flow lines, for preparing photomaps at various scales, and for map revision. Other experiments will include delineation and change detection of gross ice features, measuring seasonal variations of sea-ice boundaries, and mapping regional areas at 1:10,000,000 scale. F.R.L.

A73-39869 # Thermal structure of the sand desert from the data of IR aerophotography. B. V. Vinogradov, A. A. Grigor'ev, V. B. Lipatov, and A. P. Chernenko (Moscow Institute of Aerospace Methods, Moscow, USSR). In: *International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1.* Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 729-737. 19 refs.

A73-39870 # Radiometric terrain mapping at 3 mm wavelength. E. Schanda, G. Schaerer, and M. Wüthrich (Bern, Universität, Berne, Switzerland). In: *International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1.* Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 739-745. 5 refs.

A narrow beam (10 arcminutes) microwave scanning radiometer, operating at 92 GHz has been used for thermal mapping. Real time display of the sceneries is performed on a TV screen. Radiometric images of distant areas, urban sceneries and single buildings are presented and some special features are discussed. The data acquisition system of the radiometer is equipped with a calculator which performs the subtraction of the informations of different images, thus enabling the display of the changes within a certain scenery. (Author)

A73-39872 # The reliability of the interpretation of soils from aerial photographs in highway planning practice. U. Kihlblom. In: *International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1.* (A73-39829 20-13) Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 755-763. 6 refs.

A73-40133 Applications of diffused pulsed lasers to geodesy. Y. Suzaki and A. Tachibana (Hitachi, Ltd., Yokohama, Japan). *Applied Optics*, vol. 12, Sept. 1973, p. 2031-2033.

Diffused pulsed laser light scattered from high altitude can be detected by simple receiving devices over a wide area on the ground, and can be applied to the geodetic survey system. The diffused laser pulses are shot from the laser oscillator carried on the artificial satellite to the ground, the signals being detected by several receivers with the clocks located on the ground. The most important technical problem is the synchronization of the clocks located at the known stations. When using diffused pulse lasers in geodesy, the wide range geodetic survey system can be formed by simple optical systems on the ground, many unknown positions can be measured at the same time, and high accuracy will be achieved by using a very short duration optical pulse. F.R.L.

A73-40813 # The programme 'Arctic-Antarctic' - Preliminary results. S. K. Tatevian (Akademiia Nauk SSSR, Astro-

nomicheskii Sovet, Moscow, USSR). *COSPAR, Plenary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper. 6* p.

The principal object of the program considered is the determination of the lengths and directions of a number of lines which connect 8 principal locations. These locations include Mirny (Antarctic), the Kerguelen Island, Afgoy (Somaly), Chartum (Sudan), Helwan (Egypt), Uzhgorod (USSR), Zvenigorod (USSR), and Barentsburg (Spitsbergen). The precisely reduced lengths and directions of each line will provide the base for a new geodetical survey. The work conducted is reviewed, giving attention to the simultaneous laser-optical observations obtained and the satellites involved. G.R.

A73-41329 # Uses of Geociever as a geodetic instrument. B. B. Holland (Johns Hopkins University, Silver Spring, Md.). In: *Space research XIII; Proceedings of the Fifteenth Plenary Meeting, Madrid, Spain, May 10-24, 1972, Volume 1.* Berlin, East Germany, Akademie-Verlag GmbH, 1973, p. 65-72. 12 refs. Contract No. N00017-72-C-4401.

The precision capabilities and accuracy experience of the Geociever passive Doppler receiver are reported. Geociever receives either of two frequency pairs 150/400 or 162/324 MHz and operates with 120 watts. Paired frequencies are used for first-order ionospheric refraction correction. The instrument is portable (45.6 kg) and is commercially available. Error sources are enumerated and quantified to provide an overall positioning error figure. This figure depends upon the accuracy with which the gravity field is known, and it is limited by current knowledge to 20 meters on a single transit of a satellite. Using multiple transits, the errors approach those imposed by the receiver. These errors, and thus the ultimate positioning capability, are less than 3 meters. (Author)

A73-42589 Analysis of the results of the geometric satellite world network (Analyse der Resultate des geometrischen Satelliten-Netzwerkes). H. H. Schmid (National Geodetic Survey, Rockville, Md.). *Bildmessung und Luftbildwesen*, vol. 41, Sept. 1, 1973, p. 170-185. 5 refs. In German.

The two methods used in connection with a world-wide geodetic system include dynamic satellite geodesy and geometric satellite triangulation. The equivalence of results obtained by both methods in the case of a determination of the positional coordinates of the observational stations is the basis for a comparison of the data determined with both approaches. Statistical investigations of the results of the geometrical method are considered together with the derivation of fundamental geodetic parameters. G.R.

A73-42728 The use of near-infrared photography in the analysis of surface morphology of an Argentine alluvial floodplain. D. Conway and R. K. Holz (Texas University, Austin, Tex.). *Remote Sensing of Environment*, vol. 2, no. 4, 1973, p. 235-242. 10 refs.

N70-16214* # Motorola Inc., Scottsdale, Ariz. Advanced Development Section.

AROD GEODETIC FEASIBILITY ANALYSIS PROGRAM, Final Report

Stanley W. Attwood 26 Nov. 1969 198 p refs
(Contract NASw-1794)

(NASA-CR-107917) Avail: CFSTI, CSCL 14B

The potential performance of AROD as a satellite geodetic survey instrument was evaluated. This analysis reviews four principle areas: (1) equipment performance, (2) propagation effects, (3) geometrical effects, and (4) the benefits of advanced data processing. The main results of the study are that the ranging capability of the AROD System and advanced methods of propagation correction largely remove ranging error from geodetic survey. The principle source of error is the definition of orbital parameters and strength of figures. Geodetic survey to accuracies of 1 meter are possible with a relatively few number of passes. Author

03 GEODESY AND CARTOGRAPHY

N70-16707*# Research Triangle Inst., Durham, N.C.
GEODETIC SATELLITE ALTIMETER STUDY: A REVIEW OF ELECTROMAGNETIC SCATTERING FROM THE OCEAN SURFACE

Sep. 1969 23 p refs
 (Contract NASw-1909)
 (NASA-CR-107746) Avail: CFSTI CSCL 14B

The theory of scattering of electromagnetic waves by the sea surface as it is relevant to the design of a geodetic satellite altimeter is reviewed. The specific problem considered is the dependence of backscattered radar energy on the characteristics of the sea surface. It is found that excellent agreement exists between the various theories for normal incidence geometry. For appreciable angles away from normal incidence, the problem greatly increases in complexity. When the radius of curvature of the ocean surface is large compared to the illuminating wavelength and when the surface height statistics are normally distributed, the backscattered power is given by an integral containing the surface correlation function and the ratio of the rms (sea) wave height to the radar wavelength. If it is assumed that the surface correlation function is isotropic and that the ratio of the (ocean) wave height to radar wavelength is very large, the integral is evaluated to show that the backscattered power at normal incidence is inversely proportional to the mean square slope of the sea surface. Author

N70-16958# Army Foreign Science and Technology Center, Washington, D.C.

GEOGRAPHIC CORRELATIONS IN DISTANT EXTRAPOLATION OF INTERPRETATION CHARACTERISTICS OF LANDSCAPE ANALOGS

B. V. Vinogradov 4 Nov. 1969 59 p refs Transl. into ENGLISH from *Primenenie Aerometodov Dlya Izuch: Gruntovyykhvod*, (Russian). N. P., 1962 p 114, 143
 (AD-696915; FSTC-HT-23-740-68) Avail: CFSTI CSCL 8/7

Distant extrapolation of interpretation characteristics is determined primarily by geographic correlations and is conducted along basic geographic zones and within the limits of zone it is conducted by landscape analogs. Interpretation characteristics developed on key sections can be extrapolated for landscape analogs. Interpretation characteristics developed on key sections can be extrapolated for landscape analogs in the USSR and foreign countries. Author (TAB)

N70-17344# International Institute for Aerial Survey and Earth Sciences, Delft (Netherlands).

TOPOGRAPHIC MAPPING

A. Verdin In *its Proc. of the ITC Post-Congr. Seminar Jul. 1969* p 138-155
 Avail: CFSTI

Maps contents and uses and mapping systems are described, distinguishing between the situations in industrial and developing countries. Base maps in industrial countries must show quantity of detail and scales from 1:5000 to 1:25,000 are used. In developing countries the need is to obtain base maps for a general view of resources, and a scale of 1:50,000 is recommended. Mapping systems in industrial countries are based on existing geodetic networks with the determination of control points taking little time. Proposals for the rapid establishment of ground control maps and for a topographic mapping system to be done in phases are described for the developing countries. The equipment needed for photointerpretation in each case and the problem of map revision in industrial countries are mentioned. N.E.N.

N70-17346# International Institute for Aerial Survey and Earth Sciences, Delft (Netherlands).

CADASTRAL AND URBAN MAPPING

J. Visser In *its Proc. of the ITC Post-Congr. Seminar Jul. 1969* p 166-177
 Avail: CFSTI

A method of reducing gross errors in coordinates of points for cadastral surveys is outlined, and the use of cadastral surveys for agrarian reform is described. Photogrammetric experiments using color, monochrome, and orthophotographs in urban mapping are reviewed. N.E.N.

N70-18018# Smithsonian Astrophysical Observatory, Cambridge, Mass.

PUBLICATIONS OF THE CENTRAL BUREAU FOR SATELLITE GEODESY, VOLUME 5: BIBLIOGRAPHY ON SATELLITE GEODESY AND RELATED SUBJECTS

Jan Rolff, Barbara Alpern, and Lienna Pizer Nov. 1969 58 p refs /its Bibliography No. 5
 Avail: CFSTI

A bibliography on satellite geodesy and related topics on geophysics and celestial mechanics is presented. Satellite observations of geodetic importance, results derived from such observations, and other information of interest to those working in the field of satellite geodesy are contained in the publications. Author

N70-18213# Swedish Board of Shipping and Navigation, Stockholm.

THE AEROMAGNETIC SURVEY OF DENMARK, FINLAND, NORWAY, SWEDEN 1965

1969 60 p refs
 Avail: CFSTI

Results of a geomagnetic survey of Denmark, Finland, Norway, Sweden and their adjacent waters in autumn 1965 are charted and tabulated as a contribution to the World Magnetic Survey by the four countries in cooperation with Canada. The measurements were conducted in Canada at the Dominion Observatory as part of a larger survey which extended from the west coast of Greenland to the eastern boundary of Finland. A three-component airborne magnetometer was flown in a chartered DC-6 aircraft. Geomagnetic elements measured included D, H, Z, and F. The average spacing of the flight lines was 35 km, with an average flight altitude of 3 km above sea level. Results were conveyed to the 13th General Assembly of the International Union of Geodesy and Geophysics. A.C.R.

N70-18289# Joint Publications Research Service, Washington, D.C.

OPTIMUM FORMS OF SPACE TRIANGULATION FIGURES

B. M. Klenitskiy 12 Dec. 1969 17 p Transl. into ENGLISH from *Geodiz. i Kartograf.* (Moscow), Jan. 1968 p 7-18
 (JPRS-49432) Avail: CFSTI

Mathematical expressions are presented for determining the optimum form and size of triangulation figures and optimum satellite height. The dependence of optimum chord length and ranges on satellite height is illustrated. Two groups of triangulation rows are described: a series of successive elementary figures in which each new station is determined from the two preceding stations, and rows of successive pairs of elementary figures in which each pair of new stations is determined from the two preceding stations. It is determined that for a world network with sides 1500 to 2000 km: long the optimum satellite altitude is 800 to 1000 km; for a network with 3000 to 4500 km sides the satellite altitude is 2500 km; and for a network with 7000 km sides the optimum satellite altitude is 10,000 km. It is also pointed out that an increase in satellite altitude results in an increase in position errors. N.E.N.

N70-18462*# International Business Machines Corp., Cambridge, Mass. Center for Exploratory Studies.

CORRELATION OF GRAVIMETRIC AND SATELLITE GEODETIC DATA Interim Progress Report, 11 Sep. 1967-29 Feb. 1968

Gerald Ouellette and Pasquale Sconzo 29 Feb. 1968 49 p refs
 (Contract NAS12-598)
 (NASA-CR-86326; CES-D181; IPR-1) Avail: CFSTI CSCL 22C

A study was carried out to ascertain the prediction accuracy in the position of a satellite over a 12-hr period at orbital altitudes

where the period is approximately 100 minutes. The effect of errors in the geopotential coefficients in position predictions were studied. A base orbit was selected and analyzed extensively. The results indicate that the position of a satellite in a nearly circular orbit, inclined 45 deg, with a period of about 100 minutes can be predicted to within \pm or - 10 meters over a 12-hr period if a correlated set of geopotential coefficients is used. A numerical integration program was utilized to determine the error growth in position prediction by comparing a perturbed orbit with a nominal reference orbit. Unusual or unanticipated results in the numerical procedure were investigated analytically to determine the theoretical reasons for the behavior. The secular growth of in-track error, is discussed. The accuracy of the various published coefficient models was investigated to provide a quantitative measure of comparison between various results obtained in coefficient determination.

Author

N70-19179* International Business Machines Corp., Cambridge, Mass. Advanced Space Systems Dept.

CORRELATION OF GRAVIMETRIC AND SATELLITE GEODETIC DATA, PART 2 Interim Scientific Report, 11 Sep. 1967-29 Feb. 1968

Gerald A. Ouellette and Pasquale Sconzo 29 Feb. 1968 270 p (Contract NAS12-598)

(NASA-CR-86327; CES-D181) Avail: CFSTI CSCL 09B

This appendix contains the graphical results obtained from the computer. Each graph depicts the positional errors resulting from the inclusion of a given value for one harmonic coefficient. The values used are the standard errors associated with each harmonic as published by Rapp. This was achieved by the use of the F factor. It will be noticed that a slight variation in this technique is required in the graphs for zonal harmonics through C sub 4,0. This is simply due to the fact that these harmonics were included in the nominal trajectory. Included are some preliminary results parameterized with period (semi-major axis). The secular trend exhibited by many of the graphs is one which can be accounted for. Consequently, the prediction error in these graphs is considered to be given by the amplitude of the oscillation about the secular trend.

Author

N70-20494# Army Foreign Science and Technology Center, Washington, D.C.

USE OF AERIAL METHODS IN LANDSCAPE STUDIES

S. V. Viktorov 21 Oct. 1969 408 p refs Transl. into ENGLISH from the Russian

(AD-698170; FSTC-HT-23-1101-68) Avail: CFSTI CSCL 8/2

The collection of articles covers a wide range of problems: The use of aerial methods in the tundra, taiga, steppes, and sandy deserts; the possibilities of aerial methods for the study of regional characteristics of landscapes; and the applications of aerial photography for large-scale mapping.

Author (TAB)

N70-21729 Wisconsin Univ., Madison.

TERRAIN DIFFERENTIATION AND DISTRIBUTION IN ARCTIC ALASKA

Karl Earvil Francis (Ph.D. Thesis) 1968 169 p

Avail: Univ. Microfilms: HC \$7.80/Microfilm \$3.00 Order No. 68-17893

Through investigations of terrain, human activity, and human terrain perception in arctic Alaska, a system of terrain differentiation was developed especially suited to the arctic terrain of Alaska. The local applicability of the system has been demonstrated in a selection of terrain maps of a tract of land on the Seward Peninsula. It is suggested that effective terrain differentiation can proceed from locally determined conceptual structures. An effective means for establishing such conceptual structures is through an analytical review of some local activity which is rather ubiquitous in the area in question and which has distinct terrain associations. Because terrain associations are not systematically isolated, a properly selected activity may be expected to provide insights into terrain variation having significance that extends considerably beyond the particular

activity examined. Thus general, as well as specific, terrain differentiation is possible.

Dissert. Abstr.

N70-22498# Technische Hochschule Munchen (West Germany). Inst. fuer Astronomische und Physikalische Geodaesie.

DYNAMIC UTILIZATION OF ARTIFICIAL EARTH SATELLITES IN GEODESY [DYNAMISCHE NUTZUNG KUNSTLICHER ERDSATELLITEN IN DER GOEDAESIE]

R. Sigl In DVFLR On the Location of Satellites By Means of Lasers and Their Appl. in Various Fields Oct. 1969 p 37-43 refs In GERMAN

Avail: CFSTI

Gravimetric methods for determining the shape of the geoid and their usefulness in evaluating satellite measurements are discussed. It is shown that a series expansion in spherical harmonics is the most appropriate method and gives the best results.

ESRO

N70-23541* National Academy of Sciences-National Research Council, Washington, D.C. Div. of Engineering.

USEFUL APPLICATIONS OF EARTH-ORIENTED SATELLITES: GEODESY-CARTOGRAPHY, PANEL 13

Frederick J. Doyle (Raytheon Co., Alexandria, Va.), William M. Kaula (Calif. Univ., Los Angeles), Charles A. Lindquist (Smithsonian Astrophysical Obs.), Ivan I. Mueller (Ohio State Univ.), John V. Sharp (IMB, Kingston, N.Y.) et al 1969 53 p refs

(Contract NSR-09-012-909)

(NASA-CR-109351) Avail: CFSTI CSCL 08E

A systems approach to the technical feasibility and cost of a proposed space geodesy-cartography program is considered. The current status of the dynamic and geometric satellite programs is outlined with proposed photographic systems for the Apollo Applications Program and multiband synoptic photography. Justification for the proposed system is given along with a description of the cartographic satellites.

J.M.C.

N70-24512# Kansas Univ., Lawrence. Remote Sensing Lab.

THE RANGE ERROR STATISTICS OF A SATELLITE RADAR ALTIMETER

Han L. Lee Sep. 1969 205 p refs

(Contract N62306-67-C-0044)

(AD-699186; CRES-TR-112-2) Avail: CFSTI CSCL 17/9

A radar altimeter with one meter accuracy has been proposed for a geodetic and oceanographic satellite to measure the mean level of the surface. It is reported by Pierson that an altimeter with such an accuracy could detect (a) intermediate and smaller scale geoid features, (b) local sea surface slopes due to strong ocean current, (c) tides storm surges and tsunamis, and (d) mean sea level. Existing techniques for measuring time delay in electronic circuits are more accurate than required in the proposed system, so the primary errors are those associated with the signal fading caused by scattering from extended targets such as the oceans surface and by the biasing effects caused by the variations in sea state.

Author (TAB)

N70-24859 Advisory Group for Aerospace Research and Development, Paris (France).

ADVANCED NAVIGATIONAL TECHNIQUES

W. T. Blackband (RAE, Farnborough) Slough, England Technivision Services Jan. 1970 354 p refs Proc. of the 14th Symp. of the Avionics Panel, Milan, 12-15 Sep. 1967

(AGARD-CP-28) Copyright. Avail: Technivision, Braywick House, Maidenhead, Berks, Engl. US Distributor: Circa Publications, Inc., 415 Fifth Ave., Pelham, New York 10803 (Attn. Mr. A. L. Candido)

Conference papers pertain to the future requirements for navigation for aircraft, and for hydrographic and oceanographic vessels; general ground-based navigational aids, with particular reference to Omega; Doppler-VOR modifications; and satellites for air and marine navigation and traffic control.

03 GEODESY AND CARTOGRAPHY

N70-24885 Centre National d'Etudes Spatiales, Bretigny-sur-Orge (France).

THE FRENCH GEODETIC SATELLITES DIADEME 1 AND 2: CONTRIBUTION TO THE EXPERIMENT WITH SATELLITE NAVIGATION

J. C. Husson and A. Banchereau / *in* AGARD Advanced Navigation Tech. Jan. 1970 p 319-337 refs *In* FRENCH

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Preliminary experiments using Diademe geodetic satellites for effective localization operations are presented. Localization operations were performed by the Doppler method and laser telemetry. These satellites were used for sounding operations in the ocean. Transl. by J.M.C.

N70-27143* Massachusetts Inst. of Tech., Cambridge. Measurement Systems Lab.

COMBINING SATELLITE ALTIMETRY AND SURFACE GRAVIMETRY IN GEODETIC DETERMINATIONS

Ronald Ging-wei Eng Young (Ph.D. Thesis) Jan. 1970 148 p refs

(Grants NGL-22-009-250; NGL-22-009-062)

(NASA-CR-86375; TE-37) Avail: CFSTI CSCL08E

The deterministic problem is studied for combining satellite altimetry observations over ocean areas with surface gravimetry over land to determine the geoid and the gravity potential. By examining the existence and uniqueness of solutions to the equivalent mathematical problem, a mixed boundary value problem in potential theory for which a general solution method is not yet available; conditions for the validity of a Neumann series method of successive approximations are established using both analytical and numerical techniques. When altimetry data are weighted more heavily than gravimetry data, sufficient conditions are given for establishing, analytically, the validity of the method. When the altimetry and gravimetry data are weighted more evenly, a computer calculation demonstrates the validity of the method for a distribution of altimetry and gravimetry like that of the earth's ocean-land distribution. Author

N70-27252* Joint Publications Research Service, Washington, D.C.

BULLETIN OF OPTICAL ARTIFICIAL EARTH SATELLITE TRACKING STATIONS

11 Mar. 1970 147 p refs Transl. into ENGLISH from Byul. St. Optich. Nablyudeniya Iskusstv. Sputnikov Zemli (Moscow), no. 55, 1969 p 6 107 Presented at Seminar on Geodetic Process. of Artificial Earth Satellite Observations, Tashkent, 23-25 Nov. 1968

(JPRS-50035) Avail: CFSTI

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13. CONSTRUCTION OF COSMIC TRIANGULATION BY CHORD DIRECTIONS AND LENGTHS B. M. Klenitskiy p 125 135 refs

14. UTILIZATION OF OPTICAL OBSERVATIONS OF ARTIFICIAL EARTH SATELLITES WITH TIME ERRORS IN COSMIC GEODESY Yu. V. Batrakov p 136 145 refs

N70-27255* Joint Publications Research Service, Washington, D.C.

GENERAL REMARKS REGARDING POSSIBILITIES OF USING ARTIFICIAL EARTH SATELLITE OBSERVATIONS WHEN DEVELOPING GROUND GEODETIC NETWORKS

V. Dobachevskaya / *In its* Bull. of Opt. Artificial Earth Satellite Tracking Sta. Mar. 1970 p 22 26 refs

Avail: CFSTI

A network of points is obtained which represents satellite triangulation with lengths of sides from 1,000 to 4,000 km. The point coordinates of this network are determined in the spatial coordinate system connected with the Earth. The directions are determined of the chords joining the satellite stations, and, in particular, the azimuths of these chords, used when developing ground networks. Author

N70-27325* Aztec School of Languages, Inc., Maynard, Mass. Research Translation Div.

THE GEOLE PROJECT [LE PROJET GEOLE]

J. C. Husson Washington NASA Dec. 1969 34 p Transl. into ENGLISH from CNES Report (French), 5 Jun. 1969 31 p (Contract NASw-1692)

(NASA-TT-F-12645) Avail: CFSTI CSCL08E

The GEOLE project is centered on geodesy by satellite based on a world-wide polyhedron of radar beacons. Thus GEOLE will provide a means to separate the dynamic geodetic problem from the geometric one. The various functions and missions of the satellite are described briefly, and the methods to be used to fulfill these objectives are discussed. Author

N70-29748# Uppsala Univ. (Sweden). Geodetic Inst.
RESEARCH ON METHODS OF DETERMINING LEVEL SURFACES OF THE EARTH'S GRAVITY FIELD Final Scientific Report. 1 May 1964 - 31 Jul. 1968

Erik Tengstrom and Andreas Vogel 8 Oct. 1969 11 p refs
 (Contract AF 61(052)-766)

(AD-702486; AFCRL-70-0077) Avail: CFSTI CSCL 8/5

Contents: Studies of dispersion method to determine terrestrial refraction, the use of the results to obtain geoidal sections by means of vertical angle measurements. Geoidal studies by gravimetric method, using Rudzki reduced gravity over rugged test areas. Use of satellites to improve the gravimetric method. Horizontal pendulum studies and secular variation of gravity. Author (TAB)

N70-30512# Dominion Observatory, Ottawa (Ontario).
MAGNETIC ANOMALY MAPS OF THE NORDIC COUNTRIES AND THE GREENLAND AND NORWEGIAN SEAS, VOLUME 39, NO. 5

G. V. Haines, W. Hannaford, and P. H. Serson 1970 30 p refs
 Avail: CFSTI

A three-component aeromagnetic survey of the Nordic countries and the Greenland and Norwegian seas was carried out in the fall of 1965. The survey data was processed to yield averages over one half minute of time, or roughly 3.5 km of flight track. A regional field, in the form of a third degree polynomial, was removed from the data, and the resulting 1/2-minute residuals were plotted by computer. These residuals are represented in three ways: as residual profiles, for each magnetic component; as two-dimensional vector residuals, in two orthogonal planes; and as segments of contour lines. Attention is drawn to several large anomaly systems, although no interpretation is attempted. Author

N70-31197# Smithsonian Astrophysical Observatory, Cambridge, Mass.

THE 1969 SMITHSONIAN STANDARD EARTH (II)

E. M. Gaposchkin and K. Lambeck 18 May 1970 104 p refs
 (SAO-Spec-Rept-315) Avail: Issuing Activity

Geodetic parameters describing the earth's gravity field and the positions of satellite tracking stations in a geocentric reference frame were computed. These parameters were estimated by means of a combination of four different types of data: routine and simultaneous satellite observations, observations of deep space probes, and measurements of terrestrial gravity. This combination solution gave better parameters than any subset of data types. In the dynamic solution, precision reduced Baker - Nunn observations and laser range data of 21 satellites were used. Data from the tracking of deep-space probes were used in the form of relative station longitudes and distances to the earth's axis of rotation. In addition to these four data sets, astrogeodetic data, surface triangulation, and some recently acquired surface gravity data not included in the set used for the combinations were employed for an independent test of the solution. The total gravity field is represented by spherical harmonic coefficients complete to degree and order 16, plus a number of higher degree terms. The accuracy of the global field has been estimated as \pm or $-$ 3 m in geoid height or \pm or $-$ 8.7 mgal. Author

N70-35117# Geological Survey, Washington, D.C. Topographic Div.

INVESTIGATION OF SMALL-SCALE MAP PROJECTIONS FOR SPACE IMAGERY

Nathan Resnick Mar. 1970 14 p refs

(PB-190718; USGS-TD-70-002) Avail: CFSTI CSCL 08B

The cartographic applications and limitations of imagery from the first Yarth Resources used in preparing 1:2,000,000-scale photomaps of the United States on one (continuous) projection. The author explains the procedure for scaling the imagery for best fit to the Albers equal-area and Lambert conformal conic projections. Based on the assumptions that the internal geometry of the sensor

image will be sound and that the resolution will be no better than 100 meters, the author concludes that the image mismatch between photographs will be tolerable when the imagery is scaled to either projection for small-scale mapping of the United States
 USGRDR

N70-37382# Geological Survey, Washington, D.C. Topographic Div.

RESEARCH AND DEVELOPMENT Annual Report, Apr. 1970

Robert A. Huber, ed. Apr. 1970 62 p

(PB-192041; USGS-TD-70-003) Avail: CFSTI CSCL 08G

This annual report, covering the 12-month period ending in April 1970, summarizes the research and development activities of the U.S. Geological Survey, Topographic Division in the Office of Research and Technical Standards and in the Region offices at Arlington, Va., Rolla, Mo., Denver, Colo., and Menlo Park, Calif. The R and D projects mentioned concern the fields of cartography, field surveys, photogrammetry, and space technology.
 Author (USGRDR)

N70-38844*# Geological Survey, Washington, D.C. Topographic Div.

GEMINI PHOTOGRAPHY EVALUATION

Robert H. Nugent and Lowell E. Starr Mar. 1967 17 p /ts
 Tech. Letter NASA-69

(NASA Order R-09-020-024)

(NASA-CR-85515) Avail: CFSTI CSCL 14E

As an initial effort to demonstrate a potential use of space photography for recording elements of the terrestrial environment, selected photographs from the Gemini IV and VII spaceflights were evaluated with respect to basic cartographic requirements
 Author

N70-38888*# Geological Survey, Washington, D.C.

RESOLUTION STUDY

Robert H. Nugent and Hugh B. Loving 9 Mar. 1967 11 p ref
 /ts Tech. Letter NASA-79

(NASA Order R-09-020-024)

(NASA-CR-84634) Avail: CFSTI CSCL 08B

The effectiveness of various photogrammetric systems was analyzed on the basis of static film resolution and height-measuring capability of stereoplotters. It is assumed that all photographic systems have geometric fidelity equal to that of a metric camera, and that ground resolution deteriorates uniformly as the flight height increases. Procedural details are described, along with the mathematical approach which emphasizes the mean square error in measurements of parallax in the image plane. This gives reasonable correlation with the theoretical ground resolution approach. It is concluded that longer principal distance plotters offer advantages over the standard 6-inch principal distance plotters in producing larger model scales and smaller contour interval capabilities. In the lunar case, it is feasible to compile 25-meter contours from photographs taken with a 12-inch focal length metric camera, provided that a minimum resolution of 75 lines per millimeter is obtained.
 M.G.J.

N70-38891*# Geological Survey, Washington, D.C.

APPLICATIONS OF REMOTE SENSOR DATA TO CARTOGRAPHIC PROGRAMS

W. Sibert Jul. 1966 15 p /ts Tech. Letter NASA-51

(NASA Order R-09-020-024)

(NASA-CR-7741) Avail: CFSTI CSCL 08B

The history of natural resource surveys in the United States is briefly summarized from the western expeditions during the first half of the 19th century to the advanced satellite technology and analytical phototriangulation concepts being developed. The application of remote sensor data to topographic mapping is discussed, and several photographs indicating the potential use for map revision operations are shown. Panoramic camera applications for acquiring orbital photographs are mentioned, and the possibility of employing these cameras at heights of approximately 125

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nautical miles is considered. It is stated that the use of spacecraft as remote sensor platforms offers the unique advantage of permitting cartographic data to be collected on a national and global basis within a time frame and coverage per data-bit never before conceived. Direct dollar benefits that may be realized in cartographic programs are estimated to be approximately \$680 million annually by 1981. A.G.O.

N70-38927*# Geological Survey, Washington, D.C. Topographic Div.

ULTRA-HIGH-ALTITUDE PHOTOGRAPHY COMPILATION EVALUATION

Robert H. Nugent Mar. 1967 10 p

(NASA Order R-09-020-024)

(NASA-CR-85483; NASA-73) Avail: CFSTI CSCL 08B

Black and white photography, taken at approximately 117,000 feet with a 6 in. focal length camera over Clark County, Nevada, was compiled into a topographic map with a Kelsh plotter. Analyses indicated that horizontal and vertical accuracy could be attained to meet map accuracy standards for compiling maps at 1:250,000 scale and possibly at 1:62,500. Author

N70-38928*+ Geological Survey, Menlo Park, Calif.

TOPOGRAPHIC STUDIES OF PISGAH CRATER, CALIFORNIA

R. E. Altenhofen, J. K. Oman, and T. M. Sousa Washington 25 Jun. 1965 109 p /ts Tech. Letter NASA-7

(NASA Order R-146)

(NASA-CR-63699) Avail: CFSTI CSCL 08E

Topographic information on two sets of sub-areas within the Pisgah Crater, California are presented. The first set of sub-areas consists of two flight paths which were used to study multispectral photography, color photography, and infrared imagery. Information furnished on these flight paths consists of the numerical designation, position, and altitude of a series of wing and centerline points surveyed and targeted in the field. The second set of sub-areas was used by radar investigators. Information furnished on these areas includes plots showing the altitude and spacing of corner and intermediate points, surveyed and targeted in the field; and the location of a series of topographic profiles developed by photogrammetric means. Mosaics of aerial photographs showing sub-areas and the location of the corner and intermediate points, topographic profiles of the sub-areas at a scale of 1:600, and a description of procedures used are included. R.N.A.

N70-40739# National Academy of Sciences-National Research Council, Washington, D.C.

THE LAND OF NESTOR: A PHYSICAL GEOGRAPHY OF THE SOUTHWEST PELOPONNESE

William G. Loy [1970] 187 p refs

(Contract N00014-67-A-0244-0001)

(AD-708419) Avail: NTIS CSCL 8/6

This study attempts to reconstruct the Late Bronze Age landscape of the southwest Peloponnese by determining the modern distributions of these physical patterns, investigating the processes that have changed them over the past three millennia, and applying these changes to the modern distribution in order to arrive at an estimate of the Late Bronze Age conditions. The basic physical patterns of landscape have been studied in a systematic fashion, hitherto impossible, through the agency of relatively large-scale stereographic aerial photographs. In every phase of the work, aerial-photo interpretation has been supplemented by the study of topographic and distribution maps, the use of diverse archival materials, extensive field checking, and a wide range of field techniques. Author (TAB)

N70-41075*# Geological Survey, Washington, D.C.
POTENTIAL TIME-COST BENEFITS FROM USE OF

ORBITAL-HEIGHT PHOTOGRAPHIC DATA IN CARTOGRAPHIC PROGRAMS

Lowell E. Starr and Winston Sibert Aug. 1966 23 p refs /ts Tech. Letter NASA-54

(NASA Order R-09-020-024)

(NASA-CR-77069) Avail: NTIS CSCL 08B

The advantages and applications of civilian use of orbital remote sensing data, especially photographic data, in the cartographic field are discussed. Monetary benefits derived from use of topographic maps are described, and estimates of direct dollar benefits annually resulting from availability of useful orbital-height photographic data are presented. Global considerations focus on the comparative cost of data collection and the current status of aerial photographic coverage and world mapping. The prime value of orbital photographic systems is its capability to collect data on a national and global basis within a time frame and with a coverage per data-bit at significant cost savings and increased production rates. S.P.

N70-41145# Aeronautical Chart and Information Center, St. Louis, Mo. Geophysical and Space Sciences Branch.

MATHEMATICAL CARTOGRAPHY, VOLUME 2

A. V. Graur 1970 331 p refs Transl. into ENGLISH from the book "Matematicheskaya Kartografiya" Leningrad: Leningrad Univ., 1956 p 348-761

(AD-709180; ACIC-LD-56-Vol-2) Avail: NTIS CSCL 8/2

The document consists of volume 2 of the textbook Mathematical Cartography. TAB

N70-42142# Department of Agriculture, Washington, D.C. Forest Service.

LAND RESOURCE INVENTORY AND ENGINEERING SURVEYS USING PHOTOGRAMMETRY Engineering Technical Report

John R. Swinnerton Aug. 1970 26 p Reprinted

(ETR-7100-2). Avail: Issuing Activity

Land resource management plans for the national forests, based on the multiple use concept, has made it necessary to obtain accurate and comprehensive land inventory surveys. A project is reported aimed at the application of new techniques and procedures to forest land resource inventory, engineering surveys and design, and automated mapping. Techniques include the use of color photography, analytical bridging and block adjustment multi-scale control extension, and the use of the electronic computer and the electronic coordinatograph. A total systems approach is described and the progress in its utilization is outlined. D.L.G.

N71-11163*# Kansas Univ., Lawrence. Remote Sensing Lab.

SNOWFIELD MAPPING WITH K-BAND RADAR

William P. Waite and Harold C. MacDonald /n NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 3 1969 22 p refs

Avail: NTIS CSCL 08L

Analysis of K-band imagery from several geographic areas where snowfields occur has provided evidence that the distribution of perennial snow results in an anomalously high signal return. In contrast to normal snow survey methods, it appears feasible to map the areal extent of old snow areas irrespective of most weather conditions, and even when covered with new fallen snow. Author

N71-14791*# Raytheon Co., Sudbury, Mass. Wayland Labs.

SPACE GEODESY ALTIMETRY VERIFICATION EXPERIMENT DESIGN STUDY (VEDS) Final Report

Ephraim Weiss and L. F. Coppenrath, ed. Apr. 1970 436 p refs

(Contract NASw-1920)

(NASA-CR-115897; SR70-4108) Avail: NTIS CSCL 08E

A study was conducted for NASA OSSA & NASA Wallops Station to design an experiment to verify the performance of a 5-meter spaceborne altimeter operating over the sea surface in

1972 and to derive data to aid in the design of higher performance altimeters. Four methods of verification are presented and analyzed, indicating that precision can currently be verified to within 3 meters, and with appropriate modifications, accuracy can be verified to 5 meters. Error studies identify current limitations on verification. Design data requirements and altimeter implications are identified for echo waveform, backscatter coefficient, and correlation time.

Author

N71-16127* Geological Survey, Washington, D.C.

MISSION 73 AND ASSOCIATED TESTS

Robert H. Alexander. In NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 1 1968 33 p ref

Avail: NTIS CSCL08F

Results from multisensor remote aerial imaging experiments in southern California established that: (1) Hasselblad cameras with color infrared films are superior to other cameras for land-use identification; (2) calibrated scanning microwave radiometers are applicable in soil moisture determinations but should be correlated with point measurements on the ground; (3) infrared radiometers are suitable for quantitative temperature measurements over urban areas; and (4) scanning microwave radiometers can record areas of wind disturbance and hence horizontal energy transfers over bodies of open water.

G.G.

N71-17833# DBA Systems, Inc., Melbourne, Fla.

NEAR TERM PROSPECTS FOR POSITIONAL ACCURACIES OF 0.1 TO 1.0 METERS FROM SATELLITE GEODESY Final Report, May 1969 - Aug. 1970

Duane C. Brown 20 Aug. 1970 99 p refs

(Contract F19628-69-C-0264)

(AD-715292; AFCL-70-050123) Avail: NTIS CSCL8/5

An investigation is made into four specific approaches to geodetic positioning that hold promise for improvements in accuracies by an order of magnitude over accuracies to be expected from the geodetic satellite programs of the 1960s.

Author (GRA)

N71-19022* RAND Corp., Santa Monica, Calif.

MAPPING BY COMPUTER GRAPHICS: SATELLITE ANTENNA COVERAGE

N. C. Ostrander Oct. 1970 50 p

(Contract NASw-1952)

(NASA-CR-116814; R-525-NASA) Avail: NTIS CSCL08B

The potential of directive satellite antennas has been investigated for the assessment of earth coverage attainable with a given satellite, antenna characteristics, and pointing direction. The coverage of geographic and political areas is often displayed and examined by superposing contours of marginal radiation intensity upon maps. An alternative to the construction of a large number of overlays is to construct a map projection (polar perspective) upon which a single overlay (representing a beam of given angular cross section) is valid over the entire map. The projection is virtually a picture of the earth as seen from the satellite, and each contemplated satellite position requires the preparation of a corresponding map. A number of such maps were constructed and proved to be highly useful in preparing the illustrative example of a worldwide television system. Described are some of the more common map types generated from a data tape of 10,000 points by computer.

Author

N71-19261* Geological Survey, Washington, D.C.

CARTOGRAPHY

Alden P. Colvocoresses. In NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 1 1969 8 p

Avail: NTIS HC\$6.00/MF\$0.95 CSCL08B

A review is given of the earth resources cartographic applications program as currently being implemented within the Topographic Division of the U.S. Geological Survey. The subject areas considered include: (1) goals of the program, (2) development of in-house capabilities, (3) relationship to NASA (MSC) aircraft program, and (4) current work on space imagery.

Author

N71-24075* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

ORBITAL ANALYSES OF THE QUICK LOOK ASTROSOVIET OPTICAL TRACKING DATA FROM THE ISAGEX PRELIMINARY EXPERIMENT, 15 SEPTEMBER - 31 OCTOBER, 1970

J. G. Marsh, J. P. Murphy, and R. W. Agreen Nov. 1970 42 p (NASA-TM-X-65488; X-552-70-450) Avail: NTIS CSCL 22A

During the period of September 15 to October 30, 1970, a Preliminary ISAGEX Experiment was conducted as a test of the networks to provide timely accurate quick look data. Some preliminary conclusions regarding this pre-experiment are presented. Since Baker-Nunn data has been used for over a decade at Goddard for orbit determination, this study was primarily concerned with processing the NAFA-25 observations made available during this period which have heretofore never been available. Results are presented when these data are used in orbit computations and predictions along with other quick look data. Preliminary results indicate that the accuracy of these data are of the order of a few minutes of arc.

Author

N71-25123# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

GLOBAL PHOTOGRAPHY OF THE EARTH AND POSSIBILITIES FOR INTERPRETING ITS DATA

B. V. Vinogradov et al 10 Nov. 1970 22 p refs Transl. into ENGLISH from the Russian

(AD-719781; FTD-HT-23-505-70) Avail: NTIS CSCL 8/2

The global photographs obtained from high-orbiting satellites Molniya, ATS, and spaceships Zond and Apollo represent super-small-scale space photographs or televised images of the Earth. Methods of using them for obtaining both global and area information on the natural complexes of the Earth's surface - the geographical zones and topography - are discussed.

Author (GRA)

N71-26287# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATING THE DECODABILITY OF SMALL TOPOGRAPHIC OBJECTS IN LARGE-SCALE AERIAL PHOTOGRAPHY

L. M. Goldman 11 Jan. 1971 17 p refs Transl. into ENGLISH from Tsentr. Nauchn.-Issled. Inst. Geod., Aerosemki i Kartografii, Tr. (Moscow), no. 149, 1964 p 127-139

(AD-720765; FTD-HC-23-671-70) Avail: NTIS CSCL 14/5

Studies of the recognizability of small topographic objects in various types of large-scale aerial photographs were conducted for the purpose of establishing to what extent the application of each of their types increases the possibility of an office and field type decoding and permits a reduction in the ground-based pre-surveying of the objects not reflected during the aerial photographing in the scales governed by the instructions. Experimental studies were conducted in a wooded region where the recognizability of the small topographic objects is minimal, and in an open populated region where the concentration of such objects is fairly high.

Author (GRA)

N71-27054# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

LASER RANGEFINDING. PARTICIPATION OF ONERA TO GEODESY OPERATIONS THROUGH DIADEME SATELLITES [LA TELEMETRIE LASER. PARTICIPATION DE

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L'ONERA AUX OPERATIONS DE GEODESIE AU MOYEN DES SATELLITES DIADEME]

Roland Moreau and Claude Veret 1969 49 p refs In FRENCH; ENGLISH summary Sponsored by Direc. Rech. et Moyens d'Essais (ONERA-NT-156) Avail: NTIS

A mobile station of laser rangefinding has been designed and built at ONERA; it has been operated in 1967 at Colomb-Bechar (South West Algeria) in order to take part in geodetic experiments through the DIADEME satellites, under the sponsorship of CNES (the French Space Agency) and DRME (Research Department of the Defence Ministry). The interest of laser, as compared to that of radio frequency radars, is shown; then the various parts of a laser rangefinder are examined in detail: optical transmitter-receiver device, electronic circuits for measurements and dating, consequences of the use of retroreflectors (cube corners) on the target. The measuring station used for the geodesy experiments is described, as well as the results obtained. Lastly are examined the improvements that could be applied to the equipment to augment the maximum range or the accuracy, and various other fields of application are mentioned. Author (ESRO)

N71-31147*# Scientific Translation Service, Santa Barbara, Calif. TECHNIQUES OF SPACE GEOGRAPHY, WAYS OF DEVELOPING THEM AND THEIR USES IN STUDYING THE EARTH'S NATURAL RESOURCES [KOSMICHESKIYE METODY ZEMLEVEDENIYA, PUTI IKH RAZRABOTKI I PRIMENENIYA DLYA IZUCHENIYA PRIRODNYKH RESURSOV ZEMLI]

B. V. Vinogradov et al Washington NASA Jul. 1971 32 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Geofiz. (Moscow), no. 2, 1970 p 86-102 (Contract NASw-2036)

(NASA-TT-F-13810) Avail: NTIS CSCL08E

Methodology for studying the earth's natural resources is presented and the use of these space geography techniques in similar studies of other planets is demonstrated. Space geography is defined as the study of local, regional, zonal, and planetary relationships in the composition, structure dynamics, and rhythm of the geographic sphere. Space geography techniques consist of three major methods of integrating images of the earth from space observations: (1) territorial integration which involves unifying in one image, vast and spatially remote elements of the geosphere in large macro- and mega-structures; (2) factor integration which consists of uniting in one image all the physiognomic components of the geosphere, determining the relation between components in the landscape, and finding latent components of the geosphere using tracers; and (3) dynamic integration which is based on a comparison of successive images of the same territory, obtained by the same recorders with various time intervals. D.L.G.

N71-31871*# Aeronautical Chart and Information Center, St. Louis, Mo.

AIR FORCE USE OF GEODETIC SATELLITE DATA

H. Leroy Kuykendall In NASA. Goddard Space Flight Center Proc. of the GEOS-2 Program Rev. Meeting, Vol. 4 Nov. 1970 p 57-68

Avail: NTIS CSCL08E

The dynamic application of the GSP data is concerned primarily with the determination of an earth gravitational model and tracking station location from a combination of Baker-Nunn and Doppler data supplemented with existing surface gravity anomalies. To date, Kaula's analytic procedures have been used for computing an earth gravitational model. Author

N71-32950# Defense Documentation Center, Alexandria, Va. PHOTOGRAMMETRY Report Bibliography, Apr. 1947 Mar. 1970

May 1971 141 p refs

(AD-724510; DDC-TAS-71-21-1) Avail: NTIS CSCL8/2

The bibliography contains annotated references on Photogrammetry. Some of the topics are: geodetic photogrammetric research and technique development, computer programs for the reduction of photogrammetric cloud data; electronic photogrammetry, some thoughts on automation in photography, aerial photography used in mapping vegetation and soils, and some new approaches in photogrammetric techniques. Author (GRA)

N71-32983# Kansas Univ., Lawrence. Center for Research. GEOMORPHIC EVALUATION OF RADAR IMAGERY OF SOUTHEASTERN PANAMA AND NORTHWESTERN COLOMBIA

Anthony J. Lewis Feb. 1971 178 p refs

(Contract DAAK02-68-C-0089)

(AD-724118; CRES-TR-133-18; ETL-CR-71-2) Avail: NTIS CSCL8/2

The purpose of this study is to evaluate the potential of radar imagery for use in geomorphic analysis, using southeastern Panama, including Route 17, and northwestern Colombia as the test site. More specifically, radar-derived morphometric data will be compared to morphometric data from 1:50,000 maps of Route 17 and from the limited aerial photography of eastern Panama. The consistency of radar-derived morphometric data will be tested at different depression angles and look-directions. Author (GRA)

N71-33184*# Raytheon Co., Sudbury, Mass. Equipment Div. SPACE GEODESY AIRCRAFT EXPERIMENT Final Report

E. Genest May 1970 268 p refs

(Contract NASw-1932)

(NASA-CR-121379) Avail: NTIS CSCL171

Measurements of the radar pulse shape and cross section per unit area at vertical incidence from various ocean conditions were made during the 1969 to 1970 winter approximately 120 miles east of Norfolk, Va. The radar equipment consisted of an X-band transmitter, receiver, and antenna system generating pulses of ten through one hundred nanoseconds. The reflections were received on a high speed oscilloscope inside an aircraft flying at 10,000 feet. Ocean truth was provided: (1) by two cameras located in the aircraft, one of which obtained pictures which were subsequently processed to provide two dimensional Fourier transforms of the ocean surface; (2) by a NASA ship on location which provided measurements of ocean and atmospheric conditions, and; (3) by a second aircraft with a laser profilometer which provided precise measurements of the ocean waves. Author

N71-33846# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).

THE MEASUREMENTS BY GEODIMETER-2A FROM THE INSTITUTE FOR APPLIED GEODESY FOR THE WEST GERMAN PART OF THE EUROPEAN CALIBRATION LINE TROMSO-CATANIA [DIE GEODIMETER-2A-MESSUNGEN DES INSTITUTS FUER ANGEWANDTE GEODAESIE IM WESTDEUTSCHEN ANTEIL DER EUROPAEISCHEN EICHLINIE TROMSO CATANIA]

Hermann Dirk 1970 34 p refs In GERMAN; ENGLISH summary *Ist Reihe B: Angewandte Geodaesie* No. 178 (Rept-126) Avail: NTIS

Electronic distance measurements with the Geodimeter 2A in the West-German part of the European calibration line for satellite triangulations Tromso - Catania are reported. In addition to the 15 first-order lines measured between 1962 and 1966, which are part of the triangulation chain constituting this traverse, another 10 lines were measured in 1967 and 1968. The combined results of all measurements for these 25 lines are given in this report. Author

N71-33850# Institut fuer Angewandte Geodaesie, Frankfurt Am Main (West Germany).

SCALING CONTROL BY GEODIMETER NASM-2A FOR THE WEST GERMAN PART OF THE EUROPEAN MAIN

TRIANGULATION NET FROM 1959 TO 1966 [DIE MASSSTABKONTROLLEN MIT DEM GEODIMETER NASM-2A IM WESTDEUTSCHEN ANTEIL DES EUROPÄISCHEN HAUPTDREIECKSNETZES VON 1959 BIS 1966]

Hansdieter Grosse 1970 44 p refs In GERMAN (Rept-150) Avail: NTIS

The results of the geodimeter-2A measurements made in the West-German part of the European first-order triangulation net in the years of 1958 to 1966 are presented. The computation of the measured results has been based on calibration values published in No. 149 of this series. Author

N71-36206# Polish Academy of Sciences, Warsaw. OBSERVATIONS OF ARTIFICIAL EARTH SATELLITES, NO. 9, 1969

W. Dobaczewska and J. B. Zielinski 1970 392 p refs Mostly in RUSSIAN; partly in ENGLISH; partly in GERMAN Avail: NTIS

Papers are presented on celestial and orbital mechanics, geodetic uses of satellite observations, satellite sounding of the upper atmosphere, and satellite instruments and methods of observations.

N71-36227# National Academy of Sciences-National Research Council, Washington, D.C.

RESULTS IN SATELLITE GEODESY c13
J. Roff In Polish Acad. of Sci. Observations of Artificial Earth Satellites, no. 9, 1969 1970 p 209-214 refs

Avail: NTIS

Results in satellite geodesy are usually obtained by applying the least squares method. Internal accuracies presently obtained are much smaller than the external ones in some cases. Systematic errors are discussed in order to obtain improved results. Some examples are given. Author

N71-36243# Polish Academy of Sciences, Warsaw. SATELLITE OBSERVATION STATIONS IN HELWAN AND ABU SIMBEL

M. Khairi Ali (Acad. of Sci., UAR) and B. A. Figaro (Acad. of Sci. (USSR), Moscow) In its Observations of Artificial Earth Satellites, no. 9, 1969 1970 p 385-390 refs In RUSSIAN; ENGLISH summary Avail: NTIS

Astrometric observations for space geodesy according to the international research programs of Soviet synchronous observations and French Eurafrica are described. Steps are being taken for developing this work in the UAR. A second station near the temple of Abu Simbel and a new school in Cairo for observers at African stations are being established. Astronomical conditions at Abu Simbel site (latitude plus 22 deg and excellent weather conditions) are very suitable for classical astrometry.

Author

N71-36245# Polish Academy of Sciences, Warsaw. REPORT ON THE COLLABORATION OF THE ACADEMIES OF SCIENCES OF THE SOCIALISTIC COUNTRIES REFERRING TO THE PROBLEM: SCIENTIFIC STUDIES USING ARTIFICIAL EARTH SATELLITE OBSERVATIONS FOR GEODETIC AND GEOPHYSICAL PURPOSES, 1 NOVEMBER 1968 - 31 DECEMBER 1969

A. Masevich and S. Tatevyan In its Observations of Artificial Earth Satellites, no. 9, 1969 1970 p 397-409 refs In RUSSIAN

Avail: NTIS

An international conference was held in 1969. The Academies of Science of Bulgaria, Hungary, East Germany, Cuba, Mongolia, Poland, Rumania, the Soviet Union, and Czechoslovakia took part. The problems discussed included visual observations of satellites for ephemeride application, upper atmosphere research using visual and photographic satellite observations, satellite geodesy, and the improvement of the equipment for satellite observations. Transl. by K.P.D.

N72-10341# Pennsylvania State Univ., University Park. Dept. of Geology and Geophysics.

GEOMORPHOLOGY OF THE EAST FLANK OF THE SPRING MOUNTAINS, NEVADA Final Report, 1 Dec. 1967 - 30 Jun. 1971

Laurence H. Lattman 15 Jun. 1971 86 p refs (Contract F19628-68-C-0136; AF PROJ. 76287828) (AD-727037; AFCRL-71-0326) Avail: NTIS CSCL 08/7

The eastern flank of the Spring Mountains, Nevada exhibits pedimented alluvial fans derived from canyons trenching the mountains. The alluvial and colluvial fill of the canyons is undergoing excavation which exhibit at least two major standstill periods. The periods of standstill evidenced by terraces in the canyons also resulted in pedimentation of the fan surfaces and the terraces can be traced onto the fans as partially preserved pediments. The bedrock of the Spring Mountains is dominantly carbonate and extensive calichification and case-hardening has developed on the alluvial and colluvial material in the canyons and on the fans. These cementation processes are extremely rapid, developing within one year. Color aerial photography, and to a lesser extent color IR photography, allows mapping of the fan surfaces and establishment of crude estimates of cementation. Author (GRA)

N72-11338# Geological Survey, Washington, D.C. Topographic Div.

RESEARCH AND DEVELOPMENT Annual Report, Apr. 1970 - Apr. 1971

Morris M. Thompson Apr. 1971 83 p refs (PB-200279; USGS-TD-71-001) Avail: NTIS CSCL 08B

The R and D projects concern the fields of cartography, field surveys, photogrammetry, orthophotomapping, and space technology. Articles prepared for presentation at meetings and conferences or for publication in professional journals, the computer contributions series, and the manual of topographic instructions are also listed. Author (GRA)

N72-12258*# Michigan Univ., Ann Arbor.

PREPROCESSING OF MULTISPECTRAL DATA AND SIMULATION OF ERTS DATA CHANNELS TO MAKE COMPUTER TERRAIN MAPS OF A YELLOWSTONE NATIONAL PARK TEST SITE

Harry W. Smedes (Geol. Survey, Denver, Colo.), Margaret M. Spencer, and Frederick J. Thomson In NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1. 1970 25 p refs Avail: NTIS CSCL 08B

The possibility of improving the accuracy of terrain classification by preprocessing spectral data was investigated. Terrain maps were made using the following techniques: 1) preprocessing by scan angle function transformation, using the computer-selected best set of three channels; and 2) preprocessing by ratio transformation, using the specified ERTS data channels, simulated by fitting the spectral response of each of the 12 data channels to the ERTS channels by a set of weighting coefficients. By using a simple technique during printout, the maps were produced in color. The normalized scan angle function transformation resulted in the most accurate classification. The best ratio transformation for the Yellowstone Park data was the ratio of each channel to the sum of all channels. A supervised training program involving maximum likelihood decision for selecting the best spectrometer channels and similar techniques for digitizing the data of the analog magnetic tapes were used. Cloud shadows were recognized in addition to eight classes of terrain. Preprocessing of data resulted in more accurate maps, required fewer training areas (hence less preparation and computer time), and enabled much of the area formerly classified as shadow to be reclassified according to actual terrain type.

Author

N72-12264*# Geological Survey, Denver, Colo.

GEOLOGIC TERRAIN MAPPING FROM EARTH-SATELLITE AND ULTRA-HIGH AERIAL PHOTOGRAPHS

R. B. Morrison In NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 5 p

Avail: NTIS CSCL 08B

03 GEODESY AND CARTOGRAPHY

A proposal is made for mapping from aerial photographs from the EROS program. Three kinds of maps (geomorphic or landform, soil, and surficial deposit) are being prepared at 1:250,000 scale for an 8000-square-mile area between Tucson and Ajo, Arizona. Nine cameras used on NASA mission 101 provided color, color infrared, and multispectral air photos from about 60,000 feet above the terrain and with photo scales ranging from 1:60,000 to 1:240,000. This area was selected because it provides a good sample of desert terrain and is suited for improving and testing the photointerpretive techniques for mapping geologic terrain features with small-scale photos.

Author

N72-12267*# Bureau of Land Management, Washington, D.C.
GROUND TRUTH VERSUS NO GROUND TRUTH
Grover B. Torbert. In NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 3 p

Avail: NTIS CSCL 08G

The area of study was the southeastern Arizona test site and three areas within the site were studied in detail: Safford, Point of Pines, and Fort Apache-White River. These areas have terrain contrast ranging from flat arid regions to high alpine mountains. Data were obtained from the Apollo 9 photographic missions, high altitude aerial photography, and simulated ERTS-A data from high altitude aircraft. Various monoscopic and stereoscopic devices were used to analyze the features, and film density variations were studied. No ground-based data were permitted. Thematic maps were prepared for geology, geomorphology, vegetation, hydrology, and soils. Interpreted boundaries were delineated, with no collaborative data used in the interpretation. Ground-based data were gathered during the overflight of high altitude aerial photography. A further study was made using the ground truth, and the data gathered on the ground were compared with original mapping. 80% to 85% of the interpretations in the areas checked were correct. It was proved that it is possible to monitor gross features of the vigor of crop lands and vegetative cover, to type soils and classify geologic features, and to determine hydrologic conditions.

Author

N72-12270*# Geological Survey, Washington, D.C.
CARTOGRAPHY
Alden P. Colvocoresses. In NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 13 p

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 08B

The EROS Cartography Program emphasizes the relationship between topographic activities of the U. S. Geological Service and those at the NASA Manned Spacecraft Center. Its objectives are to apply remote sensing systems on high altitude aircraft and orbiting satellites for topographic, planimetric, and thematic mapping of the earth's surface. The goal is to produce specially processed imagery from which useful information can be derived for a variety of disciplines associated with earth resources. G.G.

N72-12271*# Geological Survey, Washington, D.C.
AUTOMATIC CARTOGRAPHY TECHNIQUES FOR EARTH RESOURCES RESEARCH
Dean T. Edson. In NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 12 p refs

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 08B

Progress in developing instrumentation and software for the EROS user facilities is reported. Significant progress has been made in developing the USGS binary-mode scanning digitizer which is described in detail. Other instrumentation and processes discussed include profile-generating techniques, a manual digitizer, image correlation systems, and some new photomechanical data processing techniques.

Author

N72-12321*# National Aeronautics and Space Administration, Washington, D.C.

THE DUST-SAND FLOWS AND STORMS IN THE ATMOSPHERE FROM SPACE IMAGERY

B. V. Vinogradov, A. A. Grigoryev, and V. B. Lipatov. Nov. 1971 13 p refs. Transl. into ENGLISH of Leningrad Univ. conf. paper Presented at 22d Intern. Astronaut. Federation Congr., Brussels, Sep. 1971

(NASA-TT-F-14078) Avail: NTIS CSCL 04A

The application of spaceborne photography and television for mapping and analyzing dust storms in remote areas is discussed. Global photographs are perspective for a study of the dust-sand flows of maximum extension and for fixation of separate dust structures in the latitudinal systems. Regional television images provide the most valuable information on dust-sand flows and their relationship with meteorological situation.

Author

N72-12373# Bayerische Akademie der Wissenschaften, Munich (West Germany).

CONTOURS FROM PHOTOGRAMMETRIC MEASURED GROUND PROFILES AND THEIR USEFULNESS FOR THE 1:5000 SCALE MAP Ph.D. Thesis [HOEHNENLINIEN AUS PHOTOGRAMMETRISCH GEMESSENEN GELÄNDEPROFIL-ILN UND IHRE BRAUCHBARKEIT FUER DEN KARTEN-MASSSTAB 1:5000]

Heinz Schmidt-Falkenberg 1970 160 p refs In GERMAN

Avail: NTIS

Topographic contour lines are obtained from photogrammetric determined terrain profiles by scanning and transferring stereo planigraphic measurements from the stereo model to the cartographic surface layer on a glass plate. Terrain surface representation by photogrammetric profile measurements is most accurate when profile distances are kept small. Transl. by G.G.

N72-14393# Regional Research Associates, Inc., Ann Arbor, Mich.

SPATIAL SAMPLING: A TECHNIQUE FOR ACQUISITION OF GEOGRAPHIC DATA FROM AERIAL PHOTOGRAPHS AND MAPS Final Report

Gunnar Olsson 8 May 1971 256 p refs
(Contract DAAK02-70-C-0298; DA Proj. 4A0-061102-B-52-D)
(AD-725612; ETC-CR-71-11) Avail: NTIS CSCL 08/6

Modern remote sensing techniques have produced such large numbers of images that conventional analytic and evaluative procedures are no longer sufficient. Existing spatial sampling techniques were investigated to see if information could be retrieved in a less costly and time-consuming manner. More specifically, the purpose of the project was to determine whether available techniques could be used for identifying and measuring geographic features as they are depicted on maps and aerial photographs. This final report includes 6 appendices: spatial sampling, an annotated bibliography; problems in spatial sampling; error components in scientific model building statistical properties of spatial distributions; large scale variations in spatial data; and empirical experiments in sampling of spatial phenomena.

Author (GRA)

N72-16091# Louisiana State Univ., Baton Rouge. Dept. of Geography and Anthropology.
CUMULATIVE FREQUENCY CURVES OF THE DARIEN PROVINCE, PANAMA

Anthony J. Lewis and William Waite (Arkansas Univ.) In AGARD Propagation Limitations in Remote Sensing Oct. 1971 10 p

Avail: NTIS HC \$6.00/MF \$0.95

Histograms and cumulative frequency curves of terrain slope are important in the quantitative description of geomorphic regions and aid in the study of land utilization and terrain mobility. Recently a method for obtaining such terrain slope information from radar imagery was developed utilizing the necessary relationship between terrain slope and the depression angle for the occurrence of radar shadows and the variation in depression angle from near to far range across the radar image. The characteristic shape of the cumulative frequency curves for four general geomorphic regions in Panama--plains, low hills, high hills, and mountains--proved diagnostic and substantiated

both the qualitative geomorphic boundaries and the quantitative slope data determined from radar imagery. Only quantitative regional slope information is available for the poorly mapped Darien area in Panama. Author

N72-16092* Kansas Univ., Lawrence. Dept. of Geography.
VEGETATION MAPPING WITH SIDE LOOKING AIRBORNE RADAR: YELLOWSTONE NATIONAL PARK c13
Norman E. Hardy, Jerry C. Coiner, and William O. Lockman *In*
AGARD Propagation Limitations in Remote Sensing Oct.
1971 19 p refs
(Contract NAS9-10261)
(NASA-CR-125451) Avail: NTIS HC \$6.00/MF \$0.95
CSCL 08B

The purpose of this study is to delimit the vegetation communities of Yellowstone National Park to the greatest extent possible by interpreting SLAR imagery and to identify factors which could be modified or controlled to enhance information content for any future SLAR vegetation mapping projects. The interpretation approach to the SLAR imagery was first to define the boundaries of the vegetation communities. After boundary definition, a classification of vegetation types was established based upon elevations, moisture and slope features evident in the SLAR image. To assist in the classification of the vegetation communities, a matrix interpretation key was constructed. Comparison of the vegetation map developed from SLAR and that prepared from ground truth data points to the ability of an active microwave image to provide vegetation information at the community level. Author

N72-16236# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
INFORMATION RELATIVE TO CARTOGRAPHY AND GEODESY. SERIES 2: GERMAN CONTRIBUTIONS IN FOREIGN LANGUAGES, NO. 28
1971 59 p refs
Avail: NTIS

Gravimetric and astrogeodetic methods for geodetic surveys and celestial satellite geodesy are presented.

N72-16245# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
INFORMATION RELATIVE TO CARTOGRAPHY AND GEODESY. SERIES 2: GERMAN CONTRIBUTIONS IN FOREIGN LANGUAGES, NO. 26
1970 24 p refs
Avail: NTIS

The technical facility and results for a satellite observation station in Norway are described, and a European base line computation for satellite triangulation nets is presented.

N72-16246# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
A PRELIMINARY COMPUTATION OF THE EUROPEAN BASE-LINE TROMSOE-HOHENPEISSENBERG FOR SPACE TRIANGULATIONS BY MEANS OF ARTIFICIAL EARTH SATELLITES
Dieter Ehlert and Siegfried Heitz *In its Inform. Relative to Cartography and Geodesy* 1970 p 5-8 refs

Avail: NTIS

Computations on a European base line are performed for determining the scale of the satellite worldwide net and the subordinated space triangulations with artificial satellites between the stations Tromso and Catania. Computations are based as a rule on simple or double chains of triangles and on the Bomford geoid and its corrections. Adjustment of the net is carried out on the international ellipsoid by variations of coordinates using programs produced for the readjustment of the European triangulations. G.G.

N72-16247# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).

REPORT ON SATELLITE OBSERVATIONS BY THE INSTITUT FUER ANGEWANDTE GEODAESIE AT THE SATELLITE TROMSO DURING WINTER 1968-1969

Waldermar Wassermann *In its Inform. relative to Cartography and Geodesy* 1970 p 9-17 refs
Avail: NTIS

Satellite observations at Tromso, Norway, were carried out in the framework of the West European satellite triangulation program in order to connect it with the worldwide American satellite triangulation scheme. During an observation period of about 4 months, the station received predictions and look-angle data for 566 events of the satellites PAGEOS and ECHO 2. Of these, only 312 predictions were effectively useable since the possibilities for satellite photography during winter were severely restricted by weather conditions. G.G.

N72-16279# California Univ., Riverside. Dept. of Geography.
A DEMONSTRATION OF THE USE OF THE GRID SYSTEM UTILIZING MULTISOURCE INPUTS

David A. Nichols, Jack P. Dangermond (Environ. Systems Res. Inst., Redlands, Calif.), and Raymond Postma (Environ. Systems Res. Inst., Redlands, Calif.) Aug. 1971 41 p refs
(Contract N00014-69-A-0200-5001; Task-N-387-047; Proj. Themis)

(AD-731703; TR-T-71-4) Avail: NTIS CSCL 08/2

The paper demonstrates the use of a grid cell digital system to integrate data derived from high altitude aerial photographs with other sources of information (e.g. topography, road maps, geology, etc.). The system has the capabilities of data storage, retrieval, and manipulation. A data bank file possessing spatial characteristics can be displayed with computer graphics, and manipulated in the computer. The demonstration involves the application for a regional park location model. Author (GRA)

N72-18336* Oregon State Univ., Corvallis.
A PRELIMINARY VEGETATIONAL RESOURCE INVENTORY AND SYMBOLIC-LEGEND SYSTEM FOR THE TUCSON-WILCOX-FORT HUACHUCA TRIANGLE OF ARIZONA
Charles E. Poulton, Barry J. Schrupf, and Edmundo Garcia-Moya *In Calif. Univ. Monitoring Earth Resources from Aircraft and Spacecraft* 1971 p 93-109
Avail: NTIS; SOD \$4.00 CSCL 02F

The methods used for mapping natural vegetation and related physiographic features of the Tucson-Willcox-Fort Huachuca triangle of Arizona, are discussed. The procedures and mapping examples are based on cartographic principles and symbolic legend concepts developed in previous programs. Aerial and spaceborne photography are also used. E.H.W.

N72-18373* Geological Survey, Washington, D.C.
MAPPING MONTANE VEGETATION IN SOUTHERN CALIFORNIA FROM COLOR INFRARED IMAGERY
Richard A. Minnich (Calif. Univ., Riverside), Leonard W. Bowden (Calif. Univ., Riverside), and Robert W. Pease (Calif. Univ., Riverside) Apr. 1969 73 p refs Prepared by the Geol. Surv. in cooperation with Calif. Univ., Riverside. Dept. of Geography
Original contains color illustrations
(NASA Order R-09-020-024; NASA Order W-12570; Contract DI-14-08-0001-10674; 160-75-01-32-10)
(NASA-CR-125645; USGS-IR-NASA-152) Avail: NTIS
CSCL 08B

Mapping a large area in California like the San Bernardino Mountains, demonstrated that color infrared photography is suitable for detailed mapping and offers potential for quantitative mapping. The level of information presented is comparable or superior to the most detailed mapping by ground survey. Author

N72-19356* Ohio State Univ. Research Foundation, Columbus. Dept. of Geodetic Science.
BASIC RESEARCH AND DATA ANALYSIS FOR THE NATIONAL GEODETIC SATELLITE PROGRAM Semiannual Status Report, Jul. - Dec. 1971
Jan. 1972 68 p refs

03 GEODESY AND CARTOGRAPHY

(Grant NGL-36-008-093; OSURF Proj. 2514)

(NASA-CR-125687; SASR-9) Avail: NTIS CSCL 08G

Investigations of triangulation nets and scaling are reported. Adjustment of the BC-4 worldwide geometric satellite triangulation net is described, along with procedures for correcting type II data and the contents of magnetic tapes containing data from the Pageos network. Computational steps for the further reduction of partially reduced satellite image plate coordinates are outlined. The problem of improving existing triangulation systems by means of satellite super-control points was studied. The SAO-69 geometric solution was scaled with C-band radar data, resulting in SAO and C-band adjustment compatible with one another in the Western Hemisphere. The North America solution NA-6, obtained from GEOS 1 data, was readjusted with new heights as constraints on all 30 optical stations and is referred to as the NA-8 solution. N.E.N.

N72-19578# Purdue Research Foundation, Lafayette, Ind.
STUDY OF POTENTIAL APPLICATION OF HOLOGRAPHIC TECHNIQUES TO MAPPING Final Technical Report, Oct. 1970 - Sep. 1971

Maurice K. Kurtz, Jr., N. Balasubramanian, Edward M. Mikhail, and Warren H. Stevenson Oct. 1971 273 p refs
(Contract DAAK02-69-C-0563; DA Proj. 4A0-61102-B-52-C)
(AD-734327; ETL-CR-71-17) Avail: NTIS CSCL 08/2

The potential uses of optical holography in photogrammetric mapping are identified. Techniques are given for presenting information which has been quantitatively extracted by mapping holographic virtual images of realistic objects and terrain. During measurement, with a self-illuminated measuring mark, it was found that the position accuracy varies inversely with magnification and directly as the square of the viewing distance to the image. By modifying the Wild A7 Autograph so that the holographic virtual image could be absolutely oriented it was possible to map the image both digitally and by plotting detailed outlines, planimetry, profiles and contours. It is believed that the first topographic maps ever made from holographic images were produced. Author (GRA)

N72-21375# Woods Hole Oceanographic Institution, Mass.
HUDSON '70 GRAVITY OBSERVATIONS 62.9 DEGREES - 57.5 DEGREES N ALONG 150 DEGREES W

W. S. Vonarx, D. C. Bowen, J. P. Dean, and R. T. Haworth Nov. 1971 67 p
(Contract N00014-66-C-0241; NR Proj. 033-004)

(AD-735114; WHOI-Ref-71-68) Avail: NTIS CSCL 08/5

To provide geoidal topography over the world oceans, a radar altimeter carried by earth satellite is planned. Ground truth calibration will be provided by a grid comprised of the equatorial belt and meridional traverses along the 30 degrees W and 150 degrees W meridians. Ground truth topography is derived from gravity values measured along these traverses. This report presents the free air gravity values and the computed free air anomalies obtained from 62.9 degrees S to 57.5 degrees N along the 150 degrees W meridian. Author (GRA)

N72-22421# Army Foreign Science and Technology Center, Charlottesville, Va.

BASIC METHODS OF TECHNOLOGICAL PROGRESS IN TOPOGRAPHIC-GEODETIC AND CARTOGRAPHIC AFFAIRS

L. A. Kashin 7 Oct. 1971 15 p Transl. into ENGLISH from Geod. Kartograficheskoy (USSR), no. 3, 1969
(AD-736001; FSTC-HT-23-801-71) Avail: NTIS CSCL 08/2

The history of technical progress on various levels of topography, geodesy, and cartography in the USSR is traced and its future mapped. Author (GRA)

N72-24451# California Univ., Riverside.

COASTAL AND SHORE LANDFORMS OF BAJA CALIFORNIA DEL NORTE, MEXICO

Jack B. Bale and John A. Minich Aug. 1971 83 p
(Contract N00014-69-A-0200-5003; NR Proj. 387-045)
(AD-736966; TR-O-71-2) Avail: NTIS CSCL 08/6

A series of seventeen maps is presented of the coastal and shore morphology of the northern half of the peninsula of Baja California. A total of 38 classes of both shoreward and landward categories are descriptively employed to cartographically display information interpreted from uncontrolled oblique aerial photographs to existing base maps. Thirty-six examples of color infrared oblique aerial photographs used in the analysis are presented. The greatest difficulty encountered was lack of critical ground control on the photography which necessitated interpretation and resectioning of data onto small scale (1:200,000) maps. Author (GRA)

N72-26275# Department of Natural Resources and Environmental Control, Dover, Del.

SOME APPLICATIONS OF REMOTE SENSING IN ATMOSPHERIC MONITORING PROGRAMS

Austin N. Heller, John C. Bryson, and N. C. Vasuki In NASA, Washington Remote Sensing of the Chesapeake Bay 1972 p 59-71 refs

Avail: NTIS; SOD \$2.25 CSCL 04A

The applications of remote sensing in atmospheric monitoring programs are described. The organization, operations, and functions of an air quality monitoring network at New Castle County, Delaware is discussed. The data obtained by the air quality monitoring network ground stations and the equipment used to obtain atmospheric data are explained. It is concluded that correlation of the information obtained by the network will make it possible to anticipate air pollution problems in the Chesapeake Bay area before a crisis develops. Author

N72-26298# Department of Agriculture, Washington, D.C. Economic Research Service.

THE LOOK OF OUR LAND. AN AIRPHOTO ATLAS OF THE RURAL UNITED STATES: THE PLAINS AND PRAIRIES

Simon Baker, comp. and Henry W. Dill, Jr., comp. Oct. 1971 84 p
(USDA-HB-419) Avail: SOD \$1.00

An atlas is presented which brings together the text of Agriculture Handbook 296 with photos to show land use and related information according to an established regional and area classification of U.S. land resources. The airphotos were selected to show characteristics and land use in 36 resource areas in 11 States in the area along the 100th meridian. Accompanying the photos of each area is a brief description of land use, climate, soils, and topography for that area. Land uses are usually described verbally or quantitatively, or are depicted on maps. Author

N72-28395 Ecole Nationale Supérieure du Pétrole et des Monteurs, Rueil-Malmaison (France).

SOME EXAMPLES OF THE MINERVOIS DE L'HERAULT CARTOGRAPHY [DIVERS EXEMPLES DE CARTOGRAPHIE SUR LE MINERVOIS]

M. Guy In CNES Remote Sensing of Earth Resources Oct. 1971. p 342-355 refs In FRENCH

The methodology for processing of geological data obtained from remote sensing of the Minervois de l'Hérault test zone is presented. Results were obtained concerning the optimal dates for scanning of this area. ESRO

N72-28420# Aeronautical Chart and Information Center, St. Louis, Mo.

GEODETIC APPLICATION OF SATELLITE DATA

Thomas C. Seppelin Apr. 1971 25 p Presented at 8th Space Congr., Cocoa Beach, Fla.

(AD-738332; ACIC-Tech-Paper-71-1) Avail: NTIS CSCL 08/5

The Aeronautical Chart and Information Center has used the data obtained from the Geodetic Satellite Program in a number of ways. The investigations are divided into two separate categories which support the development of a World Geodetic System both directly and indirectly. The geometric application has been specific point positioning for the Test Ranges and the densification of geodetic control in South America. The dynamic

application has been concerned primarily with determination of an earth gravitational model and tracking station locations from a combination of optical and electronic data supplemented with existing surface gravity anomalies. The status of the various efforts is presented. Author (GRA)

N72-28449# National Academy of Sciences-National Research Council, Washington, D.C. Highway Research Board.
AERIAL SURVEYS AND PHOTOGRAMMETRY (4 REPORTS)
 Highway Research Record, No. 375
 1971 44 p refs
 Avail: NTIS HC \$4.25

Aerial surveys and photogrammetric procedures of traffic engineering for highway design and construction are presented.

N72-28450 Wisconsin Dept. of Transportation, Madison. Div. of Highways.
EVALUATION OF PHOTOGRAMMETRIC CROSS SECTIONS FOR EARTHWORK PAYMENT
 Vernon H. Schultz In NAS/NRC Aerial Surv. and Photogrammetry 1971 p 1-7 refs Presented at the 50th Ann. Meeting of the Comm. on Photogrammetry and Aerial Surv. Sponsored by Comm. on Photogrammetry and aerial surv.

Earthwork quantities were compared on four projects by using both photogrammetric final cross sections and conventional field-measured final cross sections. Original cross sections had been taken by conventional field procedures. It was found that for dual roadway sections involving 7,500 cu yd or more per station the difference between photogrammetric and field-measured yardage was 2 percent or less. On those roadway sections involving 12,000 cu yd or more per station, the difference was less than 1 percent. In all cases the photogrammetric yardage was greater than the field-measured yardage. When interpolated photogrammetric elevations were compared to field elevations, it was observed that the average mean difference showed the photogrammetric to be 0.15 ft lower than the field. It was concluded that the difference in earthwork quantities was within the range of possible error because of the average end area method of computation, and therefore the photogrammetric method will produce an accurate estimate usable for payment. Author

N72-28451 Wisconsin Dept. of Transportation, Madison. Div. of Highways.
DEVELOPMENT AND PRODUCTION OF TWO-COLOR AERIAL PHOTOMOSAIC CONTRACT PLANS
 Vernon H. Schultz and William E. Frantz In NAS/NRC Aerial Surv. and Photogrammetry 1971 p 8-14 Presented at the 50th Ann. Meeting of the Comm. on Photogrammetry and Aerial Surv. Sponsored by Comm. on Photogrammetry and Aerial Surv.

The increased complexity of highway design and construction has prompted the use of aerial photography and two color printing to depict proposed designs more easily. A soft green ink is used to show the aerial photograph background and black ink shows the proposed designs. The technique is a departure from traditional drafting methods in that a base drawing is used for one color (green) and an overlay drawing for the other color (black). This method is compatible with the modern scissors drafting or stickup technique now being used by many state highway departments. Results have shown greater clarity and increased flexibility in the use of aerial photography and better results in reproductions from black and white microfilm. Author

N72-28452 Ohio Dept. of Highways, Columbus.
AN EXPERIMENTAL INVESTIGATION OF HIGHWAY SURVEYING AND MAPPING CONTROL EXTENSION BY TRILATERATION AND CONVENTIONAL TRAVERSE c13
 Shuh-Chai Lee and Anatol Leo Belkin In NAS/NRC Aerial Surv. and Photogrammetry 1971 p 15-27 refs Sponsored by Comm. on Photogrammetry and Aerial Surv.; funded by the Federal Highway Admin.

A chain of 16 quadrilaterals approximately 6 miles in length along I-71 was used to evaluate ground control extension by trilateration and conventional traverse. Distances were measured with a geodimeter, and angles were measured with a Wild T2 theodolite. A FORTRAN computer program was developed to adjust the trilateration network. The method is based on a previously developed and published method of trilateration adjustments. The traverse adjustment was accomplished by using the least squares method. Results of the experiments show that trilateration is more accurate than conventional traverse and is at least as economical. It is recommended that a trilateration chain of quadrilaterals be used where a double centerline or double traverse is needed for highway surveying or mapping control. The methodology and computer program have permitted this method to be used wherever economically advantageous. Author

N72-29283# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
REPORTS RELATIVE TO CARTOGRAPHY AND SURVEYING. SERIES 1: GERMAN CONTRIBUTIONS AND INFORMATION, NO. 53 [NACHRICHTEN AUS DEM KARTEN- UND VERMESSUNGSWESEN. REIHE 1: DEUTSCHE BEITRAEGE UND INFORMATIONEN]
 1971 156 p refs In GERMAN
 Avail: NTIS HC \$10.25

The development of new procedures for numerical photogrammetry is discussed. The application of computer programs for improved photogrammetry and cartography is explained. Examples of lectures and demonstrations of related computer programming are included. The significance of these new developments for cadastral survey and boundary determination is emphasized.

N72-29284 Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
INCREASED EFFICIENCY IN NUMERICAL PHOTOGRAMMETRY [LEISTUNGSSTEIGERUNG IN DER NUMERISCHEN PHOTOGRAMMETRIE] c14
 F. Ackermann In its Rept. Relative to Cartography and Surveying, No. 53 1971 p 9-35 refs In GERMAN

The development and application of numerical photogrammetry based on aerial photography are discussed. The advantages and limitations of numerical photogrammetry are presented. The application of computer programs for increased accuracy of mapping and geodetic surveying is explained. The characteristics of instruments for aerial triangulation are described. Transl. by P.N.F.

N72-29285 Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
THE PROGRAM PACKAGE PAT-M FOR THREE DIMENSIONAL AEROTRIANGULATION WITH INDEPENDENT MODELS [DAS PROGRAMM-PAKET PAT-M FUER DIE RAEUMLICHE AEROTRIANGULATION MIT UNABHAENIGEN MODELLEN]
 H. Ebner In its Rept. Relative to Cartography and Surveying, No. 53 1971 p 37-50 refs In GERMAN

A computer program for three dimensional aerial triangulation is presented. The application of the procedure for point measurements in order to establish a basis for geodetic surveys is described. The principle of compensation as used with photogrammetry is examined. The use of independent models for determining coordinates and the accuracy which may be expected are reported. Transl. by P.N.F.

N72-29288 Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
COMBINED PHOTOGRAMMETRIC-TERRESTRIAL CADASTRAL SURVEY [KOMBINIERTE PHOTOGRAMMETRISCH-TERRESTRISCHE KATASTERVERMESSUNG]

03 GEODESY AND CARTOGRAPHY

In its Rept. Relative to Cartography and Surveying, No. 53
1971 p 99-122 refs In GERMAN

The capabilities of photogrammetry, with emphasis on the integration of the coordinates of terrestrial landmarks, are discussed. A program for obtaining photogrammetric coverage of selected areas of Germany is presented. The use of photogrammetry to refine the measurements of areas which have been previously mapped is explained. Transl. by P.N.F.

N72-29289 Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).

THE APPLICATION OF THE INTEGRATED PHOTOGRAMMETRIC DATA PROCESS IN FIELD MAPPING [DIE ANWENDUNG DER INTEGRIERTEN PHOTOGRAMMETRISCHEN DATENVERARBEITUNG IN DER FLURBEREINIGUNG]

K. Heiland *In its Rept. Relative to Cartography and Surveying, No. 53* 1971 p 123-134 refs In GERMAN

The practical application of photogrammetry to measure the roadways and waterways of the Baden-Wuerttemberg area of Germany is discussed. The techniques for establishing ground reference points and boundaries are explained. The accuracy obtained by the proposed methods is described. Graphs are included to compare the results obtained from various methods of coordinate determination. Transl. by P.N.F.

N72-29291 Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).

DISCUSSION OF POSSIBILITIES AND CONDITIONS FOR THE PRACTICAL APPLICATION IN PHOTOGRAMMETRIC CADASTRAL SURVEYING [DISKUSSION DER MOEGlichkeiten UND BEDINGUNGEN FUER DIE PRAKTIISCHE ANWENDUNG DER PHOTOGRAMMETRISCHEN KATASTERMESSUNG]

F. Ackermann *In its Rept. Relative to Cartography and Surveying, No. 53* 1971 p 147-160 In GERMAN

The conditions for the practical application of photogrammetry are examined. The factors which influence the accuracy of numerical photogrammetry are explained. The use of computer programs and services to process the data is described. Methods for improving the accuracy of photogrammetric data are analyzed. Transl. by P.F.N.

N72-29359* National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
MAPPING OF TERRAIN BY COMPUTER CLUSTERING TECHNIQUES USING MULTISPECTRAL SCANNER DATA AND USING COLOR AERIAL FILM

Harry W. Smedes (Geological Survey, Denver), Harold J. Linnerud (E G and G, Inc., Bedford, Mass.), Lawrence B. Woolaver (E G and G, Inc., Bedford, Mass.), Ming-Yang Su (Northrop Services, Inc., Huntsville, Ala.), and Robert R. Jayroe *In its 4th Ann. Earth Resources Program Rev., Vol. 3* 21 Jan. 1972 30 p refs Original contains color illustrations

CSCL 08B

Two clustering techniques were used for terrain mapping by computer of test sites in Yellowstone National Park. One test was made with multispectral scanner data using a composite technique which consists of (1) a strictly sequential statistical clustering which is a sequential variance analysis, and (2) a generalized K-means clustering. In this composite technique, the output of (1) is a first approximation of the cluster centers. This is the input to (2) which consists of steps to improve the determination of cluster centers by iterative procedures. Another test was made using the three emulsion layers of color-infrared aerial film as a three-band spectrometer. Relative film densities were analyzed using a simple clustering technique in three-color space. Important advantages of the clustering technique over conventional supervised computer programs are (1) human intervention, preparation time, and manipulation of data are reduced, (2) the computer map gives unbiased indication of

where best to select the reference ground control data, (3) use of easy to obtain inexpensive film, and (4) the geometric distortions can be easily rectified by simple standard photogrammetric techniques. Author

N72-29366* Geological Survey, Washington, D.C.

EARTH RESOURCES CARTOGRAPHY PROGRAM

Alden P. Colvocoresses *In NASA, Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3* 21 Jan. 1972 8 p Original contains color illustrations

CSCL 08B

Progress is reported on efforts to develop techniques of using space vehicle and high altitude aircraft imagery in cartography projects. Major efforts were made to develop an operational system for isolating specified themes from the imagery. E.H.W.

N72-29367* Geological Survey, McLean, Va. Topographic Div.
AUTOMATIC THEMATIC MAPPING IN THE EROS PROGRAM

Dean J. Edson *In NASA, Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3* 21 Jan. 1972 13 p

CSCL 08B

A specified approach to the automatic extraction and cartographic presentation of thematic data contained in multispectral photographic images is presented. Experimental efforts were directed toward the mapping of open waters, snow and ice, infrared reflective vegetation, and massed works of man. The system must also be able to process data from a wide variety of sources. Author

N72-31329*# Geological Survey, Washington, D.C.

CARTOGRAPHIC APPLICATION OF ERTS IMAGERY

Alden P. Colvocoresses, Principal Investigator 20 Sep. 1972 12 p Presented as Preliminary Findings from Analyses of ERTS Observations, NASA Goddard Space Flight Center, Greenbelt, Md., 29 Sep. 1972 Original contains color illustrations. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 (NASA Order S-70243AG-2)

(N72-10038; NASA-CR-128119) Avail: NTIS HC \$3.00 CSCL 08B

There are no author-identified significant results in this report. Results of a quick look of selected ERTS-1 imagery with respect to cartographic applications and products are presented. The term cartographic is applied to graphics that have been related to an accepted reference figure of the earth within a prescribed degree of accuracy. The results are presented in the form of figures covering: (1) nongeometric relative image quality; (2) geometric properties (preliminary); (3) first phase photoimage products; (4) intermediate phase photoimage products; (5) optimum phase orthophotoquad products; and (6) cartographic applications. Because of its unique vantage point of 920 km, ERTS-1 will be a powerful mapping tool by providing extensive and continuous up-to-date data. A.L.

N72-31370*# Ohio State Univ. Research Foundation, Columbus. Dept. of Geodetic Science.

BASIC RESEARCH AND DATA ANALYSIS FOR THE NATIONAL GEODETIC SATELLITE PROGRAM AND FOR THE EARTH SURVEYS PROGRAM Semiannual Status Report, Jan. - Jun. 1972

Jul. 1972 131 p refs
(Grant NGL-36-008-093; OSURF Proj. 2514)
(NASA-CR-128113; SASR-10) Avail: NTIS HC \$8.75 CSCL 03B

Current research is reported on precise and accurate descriptions of the earth's surface and gravitational field and on time variations of geophysical parameters. A new computer program was written in connection with the adjustment of the BC-4 worldwide geometric satellite triangulation net. The possibility that an increment to accuracy could be transferred from a super-control net to the basic geodetic (first-order

triangulation) was investigated. Coordinates of the NA9 solution were computed and were transformed to the NAD datum, based on GEOS 1 observations. Normal equations from observational data of several different systems and constraint equations were added and a single solution was obtained for the combined systems. Transformation parameters with constraints were determined, and the impact of computers on surveying and mapping is discussed. N.E.N.

N72-32346*# Geological Survey, Washington, D.C. Topographic Div.
OVERALL EVALUATION OF ERTS IMAGERY FOR CARTOGRAPHIC APPLICATION Progress Report, 1 Jul. - 31 Aug. 1972

Alden P. Colvocoresses, Principal Investigator 1 Sep. 1972 3 p Sponsored by NASA
(E72-10092; NASA-CR-128141) Avail: NTIS HC \$3.00 CSCL 08B

There are no author-identified significant results in this report.

N72-32347*# Geological Survey, Washington, D.C.
INVESTIGATION OF ERTS-1 IMAGES FOR APPLICATION TO THEMATIC MAPPING Progress Report, 1 Jul. - 31 Aug. 1972

Dean T. Edson, Principal Investigator 1 Sep. 1972 3 p Sponsored by NASA
(E72-10094; NASA-CR-128143) Avail: NTIS HC \$3.00 CSCL 08B

There are no author-identified significant results in this report.

N72-32353*# Geological Survey, McLean, Va.
CARTOGRAPHIC EVALUATION OF ERTS ORBIT AND ATTITUDE DATA Progress Report, 1 Jul. - 31 Aug. 1972

Robert B. McEwen, Principal Investigator 1 Sep. 1972 3 p Sponsored by NASA
(E72-10100; NASA-CR-128149) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. The low geometric distortion of the RBV bulk images will greatly simplify the register of multispectral images and the reference of the scene to published maps. Preparation of photomaps at scales larger than 1:1,000,000 also appears possible.

N72-32354*# Geological Survey, Denver, Colo.
A STUDY OF MORPHOLOGY, PROVENANCE, AND MOVEMENT OF DESERT SAND SEAS IN AFRICA, ASIA AND AUSTRALIA Progress Report, 1 Jul. - 31 Aug. 1972

Edwin D. McKee, Principal Investigator 1 Sep. 1972 3 p Sponsored by NASA
(E72-10101; NASA-CR-128150) Avail: NTIS HC \$3.00 CSCL 08F

There are no author-identified significant results in this report.

N72-32355*# Geological Survey, Washington, D.C.
THE CARTOGRAPHIC APPLICATION OF ERTS/RBV IMAGERY IN POLAR REGIONS Progress Report, 1 Jul. - 31 Aug. 1972

William R. MacDonald, Principal Investigator 1 Sep. 1972 3 p Sponsored by NASA
(E72-10102; NASA-CR-128151) Avail: NTIS HC \$3.00 CSCL 08B

There are no author-identified significant results in this report.

N72-32360*# Geological Survey, McLean, Va.
INVESTIGATION OF ERTS/RBV IMAGERY FOR PHOTO-MAPPING OF THE UNITED STATES Progress Report, 1 Jul. - 31 Aug. 1972

Joseph T. Pilonero, Principal Investigator 1 Sep. 1972 3 p Sponsored by NASA
(E72-10108; NASA-CR-128157) Avail: NTIS HC \$3.00 CSCL 08B

There are no author-identified significant results in this report.

N72-32385*# Alaska Univ., College.
IDENTIFICATION DEFINITION AND MAPPING OF TERRESTRIAL ECOSYSTEMS IN INTERIOR ALASKA Bimonthly Progress Report

James H. Anderson, Principal Investigator 30 Sep. 1972 2 p Sponsored by NASA
(E72-10137; NASA-CR-128191; BMPR-1) Avail: NTIS HC \$3.00 CSCL 08B

There are no author-identified significant results in this report.

N72-32401*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
DETERMINATION OF THE GEOID FROM SATELLITE ALTIMETER DATA

R. D. Brown (Computer Sciences Corp.) Sep. 1972 63 p refs (Contract NAS5-11790)
(NASA-TM-X-66016; X-550-72-268) Avail: NTIS HC \$5.25 CSCL 22C

The characteristics of the geoid surface are quantitatively described. A procedure for calculating the satellite altitude is developed. Error sources are described quantitatively, mathematically modeled, and evaluated in computer simulation. Procedures for maximum likelihood processing of altimeter data for recovery of orbit and geopotential information are presented for several geopotential models. Author

N72-32429# Army Cold Regions Research and Engineering Lab., Hanover, N.H.

TERRAIN AND COASTAL CONDITIONS ON THE ARCTIC ALASKAN COASTAL PLAIN. ARCTIC ENVIRONMENTAL DATA PACKAGE, SUPPLEMENT 1

Paul W. Sellmann, Kevin L. Carey, Charles M. Keeler, and Allan D. Hartwell Mar. 1972 83 p refs
(ARPA order 1615)

(AD-741354; CRREL-SR-165-Suppl) Avail: NTIS CSCL 08/6

The group of four reports describes the characteristics and seasonal variation of prominent relief features on and along the margin of the arctic coastal plain. These relief features include polygonal ground patterns, lake scarps and coastal features. The range of polygonal ground patterns commonly found is illustrated by a number of transects. The influence of the seasonal snow cover on relief is indicated by profiles taken during the summer and the winter. The winter profiles were taken during the period of maximum snow accumulation. The subduing influence of the seasonal snowpack is much more apparent in areas of high relief. Irregularities in the snow surface may approach those found in the more featureless areas of summer relief. A discussion of properties of the snow cover is also included from observations in the Barrow study area. Author (GRA)

N72-32448 Department of Energy, Mines and Resources, Ottawa (Ontario).

RESOURCE SATELLITES AND REMOTE AIRBORNE SENSING FOR CANADA. REPORT NO. 4: CARTOGRAPHY AND PHOTOGRAMMETRY

Dennis White, ed. 1971 17 p

(M75-2/4; Rept-4) Copyright. Avail: Issuing activity

The possible benefits to cartography and photogrammetry of Canada from remotely sensed data are discussed, concentrating on four considerations. (1) The potential impact of the proposed United States Earth Resources Technology Satellites on Canadian cartography and photogrammetry is discussed. The applications of imagery and data that might become available as a result of the proposed Skylab project are also considered. (2) The basic capability required of true cartographic satellite systems suitable for Canadian cartographic and photogrammetric applications is indicated. (3) General remote sensing requirements in

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photogrammetry and cartography. are delineated. (4) The organizational structure required to carry out a Canadian earth resources satellite and remote-sensing program is reviewed.

Author

N72-33298* Itek Corp., Lexington, Mass. Optical Systems Div.
AUTOMATED THEMATIC MAPPING AND CHANGE DETECTION OF ERTS-A IMAGES Progress Report, 18 Jul. - 15 Sep. 1972
 Nicholas Gramenopoulos, Principle Investigator 22 Sep. 1972 2 p
 (Contract NAS5-21786)
 (E72-10083; NASA-CR-128079) Avail: NTIS HC \$3.00 CSCL 08H

There are no author-identified significant results in this report.

N73-10825* Smithsonian Astrophysical Observatory, Cambridge, Mass.
ISAGEX (INTERNATIONAL SATELLITE GEODESY EXPERIMENT) EXPERIENCE. 1: DATA ACQUISITION
 E. M. Gaposchkin, ed. May 1972 150 p refs
 (Grant NGR-09-015-001)
 (NASA-CR-128396) Avail: NTIS HC \$9.50 CSCL 22C

The contributions and methods of the Smithsonian Astrophysical Observatory to the International Satellite Geodesy program are described. The report provides data users with necessary supporting information.

Author

N73-10881* Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
GEODETIC APPLICATIONS OF SATELLITE-TO-SATELLITE TRACKING. PART 1: ANALYSIS
 S. M. Yionoulis and V. L. Pisacane Feb. 1972 30 p refs
 (Contract N00017-72-C-4401)
 (AD-741683; APL-TG-1185-Pt-1) Avail: NTIS CSCL 22/3

The report is the first of a two-part study of the geodetic benefits to be derived from satellite-to-satellite tracking data. The report contains the necessary analytic expressions to be used in the simulation studies envisioned as part of the second phase. The equations for range and range rate between two satellites in orbit about the earth are complete through first order in the gravitational perturbing forces and include the effects of all powers in eccentricity. They are also completely general in that no assumptions are made as to a particular satellite pair configuration.

Author (GRA)

N73-10982* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A 3-D MULTILATERATION: A PRECISION GEODETIC MEASUREMENT SYSTEM
 P. R. Escobar, H. F. Fliegel, R. M. Jaffe, P. M. Muller, K. M. Ong, and O. H. VonRoos *In its* JPL Quart. Tech. Rev., Vol. 2, No. 3 Oct. 1972 p 1-11 ref

CSCL 08E

N73-11317* New York State Museum and Science Service, Albany.
EVALUATION OF ERTS IMAGERY AS A SPECTRAL GEOLOGICAL MAPPING TOOL IN NEW YORK STATE
 Yngvar W. Isachsen, Principal Investigator 25 Oct. 1972 1 p
 Sponsored by NASA
 (E72-10223; NASA-CR-129156) Avail: NTIS HC \$3.00 CSCL 08G

N73-12349* Geological Survey, Denver, Colo.
A STUDY OF MORPHOLOGY, PROVENANCE, AND MOVEMENT OF DESERT SAND SEAS IN AFRICA, ASIA AND AUSTRALIA Progress Report, 1 Sep. - 31 Oct. 1972
 Edwin D. McKee, Principal Investigator 1 Nov. 1972 4 p
 Sponsored by NASA

(E72-10249; NASA-CR-129126) Avail: NTIS HC \$3.00 CSCL 08F

N73-12371* Geological Survey, Washington, D.C.
THE CARTOGRAPHIC APPLICATION OF ERTS/RBV IMAGERY IN POLAR REGIONS Progress Report, 1 Sep. - 31 Oct. 1972
 William R. MacDonald, Principal Investigator 1 Nov. 1972 3 p
 (NASA Order S-70243-AG-2)
 (E72-10273; NASA-CR-129235) Avail: NTIS HC \$3.00 CSCL 08B

N73-12372* Geological Survey, McLean, Va.
INVESTIGATION OF ERTS/RBV IMAGERY FOR PHOTO-MAPPING OF THE UNITED STATES Progress Report, 1 Sep. - 31 Oct. 1972
 Joseph T. Pilonero, Principal Investigator 1 Nov. 1972 3 p
 (NASA Order S-70243-AG)
 (E72-10274; NASA-CR-129236) Avail: NTIS HC \$3.00 CSCL 08B

N73-12373* Geological Survey, Washington, D.C.
INVESTIGATION OF ERTS-A IMAGES FOR APPLICATION TO THEMATIC MAPPING Progress Report, 1 Sep. - 31 Oct. 1972
 Dean T. Edson, Principal Investigator 1 Nov. 1972 3 p
 (NASA Order S-70243-AG)
 (E72-10275; NASA-CR-129237) Avail: NTIS HC \$3.00 CSCL 08B

N73-12374* Geological Survey, Menlo Park, Calif. Topographic Div.
AN EXPERIMENT IN CULTURAL INTERPRETATION AND MAP REVISION FROM ERTS-A DATA Progress Report, 1 Sep. - 31 Oct. 1972
 William J. Kosco, Principal Investigator 1 Nov. 1972 3 p
 (NASA Order S-70243-AG)
 (E72-10276; NASA-CR-129238) Avail: NTIS HC \$3.00 CSCL 08B

N73-12375* Geological Survey, Washington, D.C.
CARTOGRAPHIC EVALUATION OF ERTS ORBIT AND ATTITUDE DATA Progress Report, 1 Sep. - 31 Oct. 1972
 Robert McEwen, Principal Investigator 1 Nov. 1972 3 p
 (NASA Order S-70243-AG)
 (E72-10277; NASA-CR-129239) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. Return beam vidicon corrected (bulk) images have been precisely enlarged and rectified to control at a scale of 1:500,000. The results closely approach National Map Accuracy Standards. A MSS scene corrected (precision) image has been prepared and printed by color lithography. This Lake Tahoe area scene is the first cartographic product from ERTS that was available for economical distribution to the public in large numbers.

N73-12376* Geological Survey, Washington, D.C. Topographic Div.
OVERALL EVALUATION OF ERTS IMAGERY FOR CARTOGRAPHIC APPLICATION Progress Report, 1 Sep. - 31 Oct. 1972
 Alden P. Colvocoresses, Principal Investigator 1 Nov. 1972 3 p
 (NASA Order S-70243-AG-2)
 (E72-10278; NASA-CR-129240) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. As a result of an examination of a set of precision processed images, the precision processor appears to be working properly and geometric quality of RBV and MSS precision and RBV bulk imagery is adequate for 1:250,000 scale while the MSS bulk is

compatible to 1:1,000,000 scale at best. However, the nongeometric quality of the MSS bulk is good for 1:250,000 scale while the MSS precision is sufficient for 1:500,000 scale. The nongeometric quality of the RBV bulk images is good for 1:250,000 to 1:500,000 scale while that of the RBV precision processed images is only rated fair and sufficient for 1:500,000 to 1:1,000,000 scale. Attempts to warp a grid to MSS bulk imagery and thus produce a useable cartographic product are being examined.

N73-12379* Itek Corp., Lexington, Mass. Optical Systems Div.

AUTOMATED THEMATIC MAPPING AND CHANGE DETECTION OF ERTS-A IMAGES Interim Report, Jun. - Nov. 1972

Nicholas Gramenopoulos, Principal Investigator Dec. 1972 19 p refs

(Contract NAS5-21786)

(E72-10281; NASA-CR-129251) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. For the exploitation of the ERTS-1 images, both multispectral and spatial pattern recognition techniques are important. A multispectral recognition software program was successfully tested. A technique for the generation of resource boundaries has been successfully combined with terrain recognition software resulting in a regionalized terrain classification system. Digital registration of multispectral images has been achieved. Also, photointerpretation results from one test site are reported and the development of spatial terrain signatures from optical diffraction patterns is described.

N73-12398# Groupe de Recherches de Geodesie Spatiale, Paris (France).

[GEOMETRICAL GEODESY] [GEODESIE GEOMETRIQUE]

Apr. 1972 42 p refs In FRENCH; ENGLISH summary

(GRRS-Bull-3) Avail: NTIS HC \$4.25

A method of processing laser range observations to obtain geodetic baselines between ground stations is presented. The processing of the whole set of observations obtained during the RCP 133 campaign (1968-1969) have given results that corroborate the reliability of the method used. Accuracies ranging from 2 to 3 meters were obtained.

N73-12399 Groupe de Recherches de Geodesie Spatiale, Paris (France).

USE OF LASER OBSERVATIONS IN GEOMETRICAL GEODESY [UTILISATION DES OBSERVATIONS LASER EN GEODESIE GEOMETRIQUE]

M. Bivas *In its Geometrical Geodesy* Apr. 1972 p 1-32 In FRENCH

The principle and results of a method of focusing laser range observations in order to obtain geodetic baselines between ground tracking stations are presented. Satellite position was calculated by several stations using both the laser echo method and sky photographs. A mathematical model for processing the position data and evaluating the time to relative positions of the tracking stations is proposed. Author (ESRO)

N73-12400 Groupe de Recherches de Geodesie Spatiale, Paris (France).

RECENT RESULTS IN GEOMETRICAL GEODESY [RESULTATS RECENTS EN GEODESIE GEOMETRIQUE]

J. L. Pieplu and A. Cazenave *In its Geometrical Geodesy* Apr. 1972 p 33-38 refs In FRENCH

Tracking data obtained from observation of the GEOS-B satellite by European stations are presented. Corrections to the Europe 50 survey are tabulated. Author (ESRO)

N73-13352* Centre National de la Recherche Scientifique, Toulouse (France). Service de la Carte de la Vegetation.

MANAGEMENT OF NATURAL RESOURCES THROUGH

AUTOMATIC CARTOGRAPHIC INVENTORY Progress Report, Aug. - Sep. 1972

Paul-Augustin Rey, Principal Investigator, Yves Gourinard, and Francis Cambou Nov. 1972 26 p Sponsored by NASA (E72-10303; NASA-CR-129552; PR-1) Avail: NTIS HC \$3.50 CSCL 08B

The author has identified the following significant results. Return beam vidicon and multispectral band scanner imagery will be correlated with existing vegetation and geologic maps of southern France and northern Spain to develop correspondence codes between map units and space data. Microclimate data from six stations, spectral measurements from a few meters to 2 km using ERTS-type filter and spectrometers, and leaf reflectance measurements will be obtained to assist in correlation studies.

N73-14331* Alaska Univ., College.

IDENTIFICATION, DEFINITION AND MAPPING OF TERRESTRIAL ECOSYSTEMS IN INTERIOR ALASKA

Bimonthly Progress Report

James H. Anderson, Principal Investigator 30 Nov. 1972 5 p

(Contract NAS5-21833)

(E72-10343; NASA-CR-129657; BMRP-2) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. A reconstituted color infrared image covering the western Seward Peninsula was used for identifying vegetation types by simple visual examination. The image was taken by ERTS-1 approximately 1120 hours on August 1, 1972. Seven major colors were identified. Four of these were matched with four units on existing vegetation maps: bright red - shrub thicket; light gray-red - upland tundra; medium gray-red - coastal wet tundra; gray - alpine barrens. In the bright red color, two phases, violet and orange, were recognized and tentatively ascribed to differences in species composition in the shrub thicket type. The three colors which had no map unit equivalents were interpreted as follows: pink - grassland tundra; dark gray-red - burn scars, light orange-red - senescent vegetation. It was concluded that the image provides a considerable amount of information regarding the distribution of vegetation types, even at so simple a level of analysis. It was also concluded that sequential imagery of this type could provide useful information on vegetation fires and phenologic events.

N73-14522# Groupe de Recherches de Geodesie Spatiale, Paris (France).

LASER TECHNIQUES IN SPACE GEODESY [TECHNIQUES LASER EN GEODESIE SPATIALE]

J. C. Husson, comp. (CNES) Jun. 1971 188 p refs Partly in ENGLISH; partly in FRENCH

(GRGS-Bull-1) Avail: NTIS HC \$11.50

Results and findings in the field of laser techniques applied to space geodesy are outlined. Selected studies on laser stations, satellite-borne instrumentation, and the tracking efficiency, are presented.

N73-15342* Itek Corp., Lexington, Mass. Optical Systems Div.

AUTOMATED THEMATIC MAPPING AND CHANGE DETECTION OF ERTS-1 IMAGES

Nicholas Gramenopoulos, Principal Investigator and H. Alpaugh Dec. 1972 22 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center,

10th and Dakota Avenue, Sioux Falls, S. D. 57198

(Contract NAS5-21766)

(E73-10006; NASA-CR-129930) Avail: NTIS HC \$3.25 CSCL 08B

The author has identified the following significant results. An ERTS-1 image was compared to aircraft photography and maps of an area near Brownsville, Texas. In the coastal region of Cameron County, natural and cultural detail were identified in the ERTS-1 image. In Hidalgo County, ground truth was located on the ERTS-1 image. Haze and 50% cloud cover over Hidalgo County reduced the usefulness of multispectral techniques for recognizing crops.

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N73-16346* Massachusetts Univ., Amherst.
MAPPING OF DUNE FIELDS IN INACCESSIBLE REGIONS
 Progress Report
 H. T. U. Smith, Principal Investigator Dec. 1972 1 p
 (Contract NAS5-21871)
 (E73-10009; NASA-CR-129933) Avail: NTIS HC \$3.00 CSCL 08B

N73-16357* Itek Corp., Lexington, Mass. Optical Systems Div.
AUTOMATED THEMATIC MAPPING AND CHANGE DETECTION OF ERTS-A IMAGES Progress Report, 15 Nov. 1972 - 15 Jan. 1973
 Nicholas Gramenopoulos, Principal Investigator Jan. 1973 4 p
 (Contract NAS5-21786)
 (E73-10023; NASA-CR-129953) Avail: NTIS HC \$3.00 CSCL 08B

There are no author-identified significant results in this report. This investigation is concerned with the development of automated interpretation techniques for the recognition and identification of earth resources. The resources will be identified by using both multispectral and spatial signatures. Ground truth data and aircraft underflight photography will be used to train the recognition algorithms. The data processed will be RBV and MSS images acquired by ERTS-1 satellite, over six test sites located in the vicinities of: Phoenix, Arizona; Weslaco, Texas; Cascade Mountains, Washington; New Orleans, Louisiana; Salt Lake City, Utah; and Salton Sea, California. The processed data will be thematic maps of resources consisting of annotated and outlined images. The seasonal changes of hydrologic and agricultural resources will also be identified. The results are expected to be applicable to a future automatic system of resource inventory and management. A.L.

N73-16374* Battelle Columbus Labs., Ohio.
REQUIREMENTS FOR A MARINE GEOID COMPATIBLE WITH GEOID DEDUCIBLE FROM SATELLITE ALTIMETRY
 D. Michael J. Fubara and A. George Mourad /in NOAA Sea Surface Topography from Space, Vol. 1 Feb. 1972 38 p refs
 CSCL 08C

Theory deficiencies, data, and potential computational procedures that make the physical determination of the ocean geoid with true scale, shape, and absolute orientation of an elusive target are outlined. Satellite altimetry potential, in combination with adequate ground support and sea truth to resolve accurate global marine geoid and other peripheral benefits associated with ocean physics, are stated. Results are given in tabular form. Author

N73-16408* Scientific Translation Service, Santa Barbara, Calif.
GEOMETRICAL METHODS OF SPACE GEODESY
 A. P. Tishchenko Washington NASA Dec. 1972 180 p refs
 Transl. into ENGLISH of the book "Geometricheskiye Metody Kosmicheskoy Geodezii" Moscow, Nauka Press, 1971
 (Contract NASw-2035)
 (NASA-TT-F-732) Avail: NTIS HC \$3.00 CSCL 08E

The fundamental principles and geometrical origins of the development of coordinated geodetic grids and the methods of coordinate tie-in of fixed and moving objects from observations of artificial earth satellites are discussed. The topics discussed include: coordinate systems, motion of artificial earth satellites, reduction of satellite observations, and solution of geodetic problems by means of artificial earth satellites. F.O.S.

N73-16466* Defense Mapping Agency Aerospace Center, St. Louis, Mo. Technical Translation Branch.
TRENDS IN SATELLITE GEODESY
 L. Stange Oct. 1972 18 p refs
 Transl. into ENGLISH from Vermessungstechnik (Dresden), v. 19, no. 3, 1971 p 81-85
 (AD-750749; DMAAC-TC-1855) Avail: NTIS CSCL 08/5
 The paper discusses the probability of further developments of satellite geodesy, based on the results achieved so far. An

increase in observation accuracy results in an immediate increase in the accuracy of the derived geodetic elements. It also opens new fields for satellite geodesy and forces a proper refinement of the underlying physico-mathematical models. Author (GRA)

N73-16313* Geological Survey, Washington, D.C.
THE CARTOGRAPHIC APPLICATION OF ERTS/RBV IMAGERY IN POLAR REGIONS Progress Report, 1 Jul. - 31 Dec. 1972
 William R. MacDonald, Principal Investigator 1 Jan. 1973 4 p
 (NASA Order S-70243-AG)
 (E73-10051; NASA-CR-130329) Avail: NTIS HC \$3.00 CSCL 08B

N73-16314* Geological Survey, McLean, Va. Topographic Div.
AN EXPERIMENT IN CULTURAL INTERPRETATION AND MAP REVISION FROM ERTS-A DATA Progress Report, 1 Jul. - 31 Dec. 1972
 William J. Kosco, Principal Investigator 1 Jan. 1973 4 p
 (NASA Order S-70243-AG)
 (E73-10052; NASA-CR-130330) Avail: NTIS HC \$3.00 CSCL 08B

N73-16315* Geological Survey, McLean, Va.
OVERALL EVALUATION OF ERTS-1 IMAGERY FOR CARTOGRAPHIC APPLICATION Progress Report, 1 Jul. - 31 Dec. 1972
 Alden P. Colvocoresses, Principal Investigator 1 Jan. 1973 16 p
 (NASA Order S-70243-AG-2)
 (E73-10053; NASA-CR-130331) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. Significant scientific conclusions are: (1) Bulk RBV's have internal positional accuracy in the order of 70 meters at ground scale while MSS internal accuracy is in the order of 200 to 300 meters. Both have precision processed images with accuracy within 70 meters. (2) Image quality exhibited by detectability and acutance is better than expected and perhaps twice as good as would be achieved by photographic film of the same resolution. (3) Photometric anomalies (shading) have limited RBV multispectral application, but it is believed that these anomalies can be further reduced. (4) The MSS has exceptionally high photometric fidelity but the matching of scenes taken under different conditions of illumination has not been resolved. (5) MSS bands 6 and 7 have enormous potential for surface water mapping including the correlation of shorelines at various water stages. (6) MSS band 7 demonstrates an actual cloud penetration capability beyond what was expected. It also has delineated cultural features better than the other MSS bands under certain conditions.

N73-16391* Geological Survey, McLean, Va. Topographic Div.
APPLICATION OF REMOTE SENSING TO PLANIMETRIC, THEMATIC, AND TOPOGRAPHIC MAPPING
 John D. McLaurin /in NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 2 1971 p 170-194 refs
 CSCL 08B

Results of studies indicate some of the potential applications of space photography to mapping. The imagery used was not optimum for mapping purposes, and there is considerable room for improvement. The ERTS-A and B satellites are expected to provide imagery that will be useful for small scale mapping, both planimetric and thematic. The repetitive coverage capability will certainly be useful for monitoring changing phenomena. However, to solve the world mapping problems, other imaging systems will have to be flown. Film-return satellites and geosynchronous satellites may have to be used together with aircraft to provide imagery for rapid and efficient mapping operations. Until such systems are in use on a worldwide basis, there is little likelihood that the planimetric and topographic map needs, particularly of the developing countries, will be met.

Author

N73-16400* Geological Survey, Denver, Colo.
AUTOMATIC COMPUTER MAPPING OF TERRAIN
 Harry W. Smedes / In NASA, Washington Intern. Workshop on
 Earth Resources Surv. Systems, Vol. 2 1971 p 344-406
 refs Sponsored in part by NASA

CSCL 08B

Computer processing of 17 wavelength bands of visible, reflective infrared, and thermal infrared scanner spectrometer data, and of three wavelength bands derived from color aerial film has resulted in successful automatic computer mapping of eight or more terrain classes in a Yellowstone National Park test site. The tests involved: (1) supervised and non-supervised computer programs; (2) special preprocessing of the scanner data to reduce computer processing time and cost, and improve the accuracy; and (3) studies of the effectiveness of the proposed Earth Resources Technology Satellite (ERTS) data channels in the automatic mapping of the same terrain, based on simulations, using the same set of scanner data. The following terrain classes have been mapped with greater than 80 percent accuracy in a 12-square-mile area with 1,800 feet of relief: (1) bedrock exposures, (2) vegetated rock rubble, (3) talus, (4) glacial kame meadow, (5) glacial till meadow, (6) forest, (7) bog, and (8) water. In addition, shadows of clouds and cliffs are depicted, but were greatly reduced by using preprocessing techniques.

Author

N73-17300*# Geological Survey, McLean, Va.
INVESTIGATION OF ERTS/RBV IMAGERY FOR PHOTO-MAPPING OF THE UNITED STATES Progress Report, 1 Jul. - 31 Dec. 1972

Joseph T. Pilonero, Principal Investigator 1 Jan. 1973 4 p
 (NASA Order S-70243-AG)
 (E73-10088; NASA-CR-130337) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. Multispectral scanner imagery substituted for the RBV imagery appears to have surpassed initial evaluation of the anticipated image quality as compared to the expected quality of the RBV imagery. A comparison of the imagery from the two systems over the same scene will help in determining the value of each system.

N73-17301*# Geological Survey, Washington, D.C.
INVESTIGATION OF ERTS-A IMAGES FOR APPLICATION TO THEMATIC MAPPING Progress Report, 1 Jul. - 31 Dec. 1972

Dean T. Edson, Principal Investigator 1 Jan. 1973 4 p
 (NASA Order S-70243-AG)
 (E73-10089; NASA-CR-130338) Avail: NTIS HC \$3.00 CSCL 08B

N73-17527*# Geological Survey, Washington, D.C. Topographic Div.

RESEARCH AND DEVELOPMENT IN TOPOGRAPHIC MAPPING Annual Report, Apr. 1971 - Apr. 1972
 Apr. 1972 74 p refs Sponsored by NASA
 (NASA-CR-130540; PB-210963; USGS-TD-72-003) Avail: NTIS HC \$5.75 CSCL 08B

Research and development activities in the following areas are summarized: (1) cartography, (2) field surveys, (3) photogrammetry, (4) orthophotomapping, and (5) space technology. Author

N73-18337*# Alaska Univ., Fairbanks. Inst. of Arctic Biology.
A NEW VEGETATION MAP OF THE WESTERN SEWARD PENINSULA, ALASKA, BASED ON ERTS-1 IMAGERY
 Interim Scientific Report
 James H. Anderson and Albert E. Belon, Principal Investigators
 20 Feb. 1973 22 p refs
 (Contract NAS5-21833)
 (E73-10305; NASA-CR-130717) Avail: NTIS HC \$3.25 CSCL 08B

The author has identified the following significant results. A reconstituted, simulated color-infrared ERTS-1 image covering the western Seward Peninsula was prepared and it is used for

identifying and mapping vegetation types by direct visual examination. The image, NASA ERTS E-1009-22095, was obtained approximately at 1110 hours, 165 degrees WMT on August 1, 1972. Seven major colors are identified. Four of these are matched with units on existing vegetation maps: bright red - shrub thicket; light gray-red - upland tundra; medium gray-red - coastal coastal wet tundra; gray - alpine barrens. The three colors having no map equivalents are tentatively interpreted as follows: pink - grassland tundra; dark gray-red - burn scars; light orange-red - senescent vegetation. A vegetation map, drawn by tracing on an acetate overlay of the image is presented. Significantly more information is depicted than on existing maps with regard to vegetation types and their areal distribution. Furthermore the preparation of the new map from ERTS-1 imagery required little time relative to conventional methods and extent of areal coverage.

N73-18360*# Geological Survey, Washington, D.C.
CARTOGRAPHIC EVALUATION OF ERTS ORBIT AND ATTITUDE DATA Progress Report, 1 Jul. - 31 Dec. 1972
 Robert B. McEwen, Principal Investigator 1 Jan. 1973 9 p
 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(NASA Order S-70243-AG)
 (E73-10329; NASA-CR-130772) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. Without the required RBV images, increased attention has been directed toward evaluating the geometric quality of MSS images. A line scan anomaly was identified and analyzed. Successive generations of images have been checked for variations in geometric distortion; it has been consistent. Some recent MSS images have about 250 m rms of relative positional accuracy although earlier images were generally over 300 m. Efforts are continuing to isolate systematic errors in MSS images but present results are inconclusive.

N73-18848# Joint Publications Research Service, Arlington, Va.

CONICAL SECTION METHOD FOR DETERMINING THE GEOMETRIC CONFIGURATION OF A PLANET BY PHOTOGRAPHS TAKEN FROM SPACE

Yu. G. Karpushin, S. V. Lebedev, and Yu. M. Neyman 23 Feb. 1973 11 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Geod. i Aerofoto's'emka (Moscow), no. 3, 1972 p 53-60

(JPRS-58304) Avail: NTIS HC \$3.00

A procedure is given for determining the geometric configuration of a planet in the form of a mathematically convenient closed surface approximating the real physical surface of the planet under a defined condition.

Author

N73-19331*# Louvain Univ. (Belgium).

THE MANKOYA-KOLWEZI STRIP (ZAMBIA, ZAIRE)

Jan DePloey, Principal Investigator and Josef Sterckx 1973 16 p refs Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
 (E73-10293; NASA-CR-130576; Rept-2) Avail: NTIS HC \$3.00 CSCL 08F

N73-19332*# Louvain Univ. (Belgium).

THE NDOLA-MWERU WANTIPA STRIP (ZAMBIA, ZAIRE)

Jan DePloey, Principal Investigator and Josef Sterckx 1973 17 p refs Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
 (E73-10294; NASA-CR-130577; Rept-1) Avail: NTIS HC \$3.00 CSCL 08F

N73-19378*# Itek Corp., Lexington, Mass. Optical Systems Div.

AUTOMATED THEMATIC MAPPING AND CHANGE DETECTION OF ERTS-1 IMAGES. PART A

03 GEODESY AND CARTOGRAPHY

N. Gramenopoulos, Principal Investigator and F. J. Corbett Mar. 1973 42 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 (Contract NAS5-21766) (E73-10385; NASA-CR-131054; PFR-73-033) Avail: NTIS HC \$4.25 CSCL 08B

The author has identified the following significant results. Automatic and accurate image processing techniques are essential to full utilization of ERTS-1 photography. In pursuit of this, terrain types in the ERTS-1 photography will be classified by spatial signatures. Diffraction patterns from selected ERTS-1 images have been developed optically and are being analyzed to identify unique signatures for various terrain types. Spatial signatures have been definitely identified for cultivated land and certain urban areas. A Fourier plane mask has been developed that greatly facilitates the analysis of the diffraction patterns.

N73-19379*# Itek Corp., Lexington, Mass. Optical Systems Div.

AUTOMATED THEMATIC MAPPING AND CHANGE DETECTION OF ERTS-A IMAGES Progress Report, 15 Jan. 1972 - 15 Mar. 1973

Nicholas Gramenopoulos, Principal Investigator Mar. 1973 4 p (Contract NAS5-21766) (E73-10386; NASA-CR-131064) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. This investigation is concerned with the development of automated interpretation techniques for the recognition and identification of earth resources. The resources will be identified by using both multispectral and spatial signatures. Ground truth data and aircraft underflight photography will be used to train the recognition algorithms. The data processed will be RBV and MSS images acquired by the ERTS-1 satellite, over six test sites located in the vicinities of: Phoenix, Arizona; Weslaco, Texas; Cascade Mountains, Washington; New Orleans, Louisiana; Salt Lake, Utah; and Salton Sea, California. The processed data will be thematic maps of resources consisting of annotated and outlined images. The seasonal changes of hydrologic and agricultural resources will also be identified. The results are expected to be applicable to a future automatic system of resource inventory and management.

N73-20380*# Nevada Univ., Reno. MacKay School of Mines. **COMPILE TWO PHOTOMAPS OF THE STATE OF NEVADA** Progress Report

Joseph Lintz, Jr., Principal Investigator 23 Mar. 1973 2 p (Contract NAS5-21864) (E73-10398; NASA-CR-131134; PR-2) Avail: NTIS HC \$3.00 CSCL 08B

N73-20361*# Alaska Univ., Fairbanks. **IDENTIFICATION, DEFINITION AND MAPPING OF TERRESTRIAL ECOSYSTEMS IN INTERIOR ALASKA** Bimonthly Progress Report

James H. Anderson, Principal Investigator 31 Mar. 1973 9 p (Contract NAS5-21833) (E73-10399; NASA-CR-131135; BMPR-4) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. A transect of the Tanana River Flats to Murphy Dome, Alaska was accomplished. The transect includes an experimental forest and information on the range of vegetation-land form types. Multispectral black and white prints of the Eagle Summit Research Area, Alaska, were studied in conjunction with aerial photography and field notes to determine the characteristics of the vegetation. Black and white MSS prints were compared with aerial photographs of the village of Wiseman, Alaska. No positive identifications could be made without reference to aerial photographs or ground truth data. Color coded density slice scenes of the Eagle Summit Research Area were produced from black

and white NASA aerial photographs. Infestations of the spruce beetle in the Cook Inlet, Alaska, were studied using aerial photographs.

N73-20371*# Geological Survey, Denver, Colo. **A STUDY OF MORPHOLOGY, PROVENANCE, AND MOVEMENT OF DESERT SAND SEAS IN AFRICA, ASIA, AND AUSTRALIA** Progress Report, 1 Jan. - 28 Feb. 1973 Edwin D. McKee, Principal Investigator 1 Mar. 1973 4 p refs (NASA Order S-70243-AG-4) (E73-10409; NASA-CR-131145) Avail: NTIS HC \$3.00 CSCL 08M

N73-21302*# Geological Survey, Washington, D.C. Topographic Div.

OVERALL EVALUATION OF ERTS IMAGERY FOR CARTOGRAPHIC APPLICATION Progress Report, 1 Jan. - 28 Feb. 1973

Alden P. Colvocoresses, Principal Investigator 1 Mar. 1973 5 p ERTS (NASA Order S-70243-AG-2) (E73-10463; NASA-CR-131529) Avail: NTIS HC \$3.00 CSCL 08B

N73-21311*# Kansas Univ./Center for Research, Inc., Lawrence. **LAND USE MAP, FINNEY COUNTY, KANSAS**

Stanley A. Morain, Principal Investigator, Donald L. Williams, and Jerry C. Coiner 11 Jan. 1973 8 p refs ERTS (Contract NAS5-21822) (E73-10474; NASA-CR-131284) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. Methods for the mapping of land use in agricultural regions are developed and applied to preparation of a land use map of Finney County, Kansas. Six land use categories were identified from an MSS-5 image. These categories are: (1) large field irrigation; (2) small field irrigation; (3) dryland cultivation; (4) rangeland; (5) cultural features; and (6) riverine land. The map is composed of basically homogeneous regions with definable mixtures of the six categories. Each region is bounded by an ocularly evident change in land use.

N73-21336*# Geological Survey, Washington, D.C. Topographic Div.

INVESTIGATION OF ERTS-1 IMAGES FOR APPLICATION TO THEMATIC MAPPING Progress Report, 1 Jan. - 28 Feb. 1973

Doyle Smith 1 Mar. 1973 3 p ERTS (NASA Order S-70243-AG) (E73-10500; NASA-CR-131530) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. Theme extractions from high quality 1:1,000,000-scale enlargements carry an encouraging amount of fine detail.

N73-21337*# Geological Survey, Washington, D.C. **THE CARTOGRAPHIC APPLICATION OF ERTS/RBV IMAGERY IN POLAR REGIONS** Progress Report, 1 Jan. - 28 Feb. 1973

William R. MacDonald, Principal Investigator 1 Mar. 1973 4 p ERTS (NASA Order S-70243-AG-2) (E73-10501; NASA-CR-131536) Avail: NTIS HC \$3.00 CSCL 08B

N73-21338*# Geological Survey, Washington, D.C. Topographic Div.

INVESTIGATION OF ERTS/RBV IMAGERY FOR PHOTOMAPPING OF THE UNITED STATES Progress Report, 1 Jan. - 28 Feb. 1973

Joseph T. Pilonero, Principal Investigator 1 Mar. 1973 2 p ERTS
(NASA Order S-70243-AG)
(E73-10502; NASA-CR-131537) Avail: NTIS HC \$3.00 CSCL 08B

N73-22305* Geological Survey, Denver, Colo.
A STUDY OF MORPHOLOGY, PROVENANCE, AND MOVEMENT OF DESERT SAND SEAS IN AFRICA, ASIA, AND AUSTRALIA Progress Report, 1 Mar. - 31 Apr. 1973
Edwin D. McKee, Principal Investigator 1 May 1973 28 p ERTS
(NASA Order S-70243-AG-4)
(E73-10542; NASA-CR-131618) Avail: NTIS HC \$3.50 CSCL 08M

N73-22367* Kansas Univ./Center for Research, Inc., Lawrence. Remote Sensing Lab.
TERRAIN FACTOR ANALYSIS AND AUTOMATIC COLOR CODED MAPPING UTILIZING THE IDECS (IMAGE DISCRIMINATION, ENHANCEMENT, COMBINATION AND SAMPLING) Final Technical Report
Philip Currier Aug. 1972 71 p refs
(Contract DAAK02-71-C-0474; DA Proj. 4A6-62707-A-854) (AD-755531; CRES-TR-208-1; ETL-CR-72-13) Avail: NTIS CSCL 08/2

The report describes a technique for automatic generation of color-coded maps which define the amount of time required to construct a military airfield. The input data is a set of terrain factors in overlay form and the technique relies upon the use of the IDECS System (Image Discrimination, Enhancement, Combination and Sampling) of the Center for Research, Inc., University of Kansas. The color-coded map is generated by a PDP-15/20 computer which reads the terrain factors which have been previously stored on the IDECS disc and applies them to a model in memory which calculates the amount of time for the airfield construction on a point by point basis. The computer then sorts the output into preselected time intervals and writes them on a digital disc. The appropriate disc channels are then displayed via the IDECS on a color television monitor for viewing as a composite color map. Author (GRA)

N73-23419* Geological Survey, McLean, Va.
CARTOGRAPHIC EVALUATION OF ERTS ORBIT AND ATTITUDE DATA Progress Report, 1 Jan. - 28 Feb. 1973
Robert B. McEwen, Principal Investigator 1 Mar. 1973 45 p ERTS
(NASA Order S-70243-AG)
(E73-10544; NASA-CR-131648) Avail: NTIS HC \$4.25 CSCL 08B

N73-23509* Smithsonian Astrophysical Observatory, Cambridge, Mass.
MATHEMATICAL METHODS APPLIED TO OCEAN-SURFACE TOPOGRAPHY AND SATELLITE GEODESY Semiannual Progress Report, 1 Jun. - 30 Nov. 1972
Charles A. Lundquist Dec. 1972 29 p refs
(Contract N00014-71-A-0110-0004; NR Proj. 301-049) (AD-755486; SAPR-1) Avail: NTIS CSCL 08/5

Two specific studies are mentioned. In the first study, the transformation matrices between spherical harmonics and spherical sampling functions have been tabulated for linear spaces truncated after degrees 22 and 36. The matrix elements were calculated by evaluating analytical expressions for the transformations and their inverses. The matrices are 529 by 529 and 1369 by 1369 arrays, respectively. These matrices allow facile transformation between equivalent earth gravity models expanded in spherical harmonics or sampling functions. In the second study, spherical sampling functions can be used instead of spherical harmonic functions in a truncated series representation for the geoid or the geopotential. The spherical sampling-function representation of the geopotential has a simple relationship to the mass-layer models or mass-concentration models suggested by other investigators. The spherical reference surface on which

the sampling points are arrayed can be transformed into a nearby surface such as an ellipsoid. Sampling functions defined for a set of concentric reference surfaces might provide a convenient representation for the mass distribution of the earth.

Author (GRA)

N73-23874* Ohio State Univ. Research Foundation, Columbus. Dept. of Geodetic Science.
GEODETIC SATELLITE OBSERVATIONS IN NORTH AMERICAN (SOLUTION NA-9)
Ivan I. Mueller, James P. Reilly, and Tomas Soler Sep. 1972 33 p refs
(Grant NGR-36-008-093; OSURF Proj. 2514)
(NASA-CR-131869; Rept-187) Avail: NTIS HC \$3.75 CSCL 22C

A new detailed geoidal map with claimed accuracies of plus or minus 2 meters (on land), based on gravimetric and satellite data, was presented. With the new geoid and the orthometric heights given, more reliable height constraints were calculated and applied. The basic purpose of this experiment was to compute the new solution NA9 by defining the origin of the system, from the point of view of error propagation, in the most favorable position applying inner constraints and imposing new weighted height constraints to all of the stations. The major differences with respect to formerly published adjustments are presented. Author

N73-24347* Environmental Research Inst. of Michigan, Ann Arbor.
YELLOWSTONE NATIONAL PARK DATA, TASK 2
Frederick J. Thomson, Principal Investigator In its ERTS-1 Invest. conducted by Environ. Res. Inst. of Mich. 9 May 1973 1 p ERTS
(E73-10567) CSCL 08B

N73-24361* Geological Survey, Washington, D.C.
OVERALL EVALUATION OF ERTS IMAGERY FOR CARTOGRAPHIC APPLICATION Progress Report, 1 Mar. - 30 Apr. 1973
Alden P. Colvocoresses, Principal Investigator 1 May 1973 2 p ERTS
(NASA Order S-70243-AG-2)
(E73-10600; NASA-CR-131998) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. The apparently successful fitting of a plane coordinate (UTM) grid to an ERTS-1 bulk image represents a breakthrough of potential economic importance. If such results continue to be attained it means that ERTS-1 imagery even in bulk form can be reproduced as planimetric image maps that meet National Map Accuracy Standards up to the 1:250,000 scale. Such maps permit positions of image points to be geodetically defined to within 75 meters (rms). Previous efforts to map with ERTS-1 images resulted in errors approaching 300 meters (rms).

N73-24363* Geological Survey, Washington, D.C.
INVESTIGATION OF ERTS/RBV IMAGERY FOR PHOTO-MAPPING OF THE UNITED STATES Progress Report, 1 Mar. 1973 - 30 Apr. 1973
Joseph Pilonero, Principal Investigator 1 May 1973 2 p ERTS
(NASA Order S-70243-AG)
(E73-10602; NASA-CR-131998) Avail: NTIS HC \$3.00 CSCL 08B

N73-24388* Geological Survey, Washington, D.C.
INVESTIGATION OF ERTS-A IMAGES FOR APPLICATION TO THEMATIC MAPPING Progress Report, 1 Mar. - 30 Apr. 1973
Dean T. Edson, Principal Investigator 1 May 1973 3 p ERTS
(NASA Order S-70243-AG)
(E73-10628; NASA-CR-132039) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. Composite mosaics made of open water extractions of the

03 GEODESY AND CARTOGRAPHY

Mississippi River at normal stage and those derived for various flood stages illustrate with startling clarity the recent flood and provide an excellent and timely historical documentation of the temporal changes in flood extent between successive cloud-free ERTS-1 passes.

N73-24393*# Alaska Univ., Fairbanks.
IDENTIFICATION, DEFINITION AND MAPPING OF TERRESTRIAL ECOSYSTEMS IN INTERIOR ALASKA
Bimonthly Progress Report
J. H. Anderson, Principal Investigator 31 May 1973 11 p
ERTS
(Contract NAS5-21833)
(E73-10634; NASA-CR-132093; BMPR-5) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. A reconstituted, simulated color-infrared print, enlarged to a scale of 1:250,000, was used to make a vegetation map of a 3,110 sq km area just west of Fairbanks, Alaska. Information was traced from the print which comprised the southeastern part of ERTS-1 scene 1033-21011. A 1:1,000,000 scale color-infrared transparency of this scene, obtained from NASA, was used along side the print as an aid in recognizing colors, color intensities and blends, and mosaics of different colors. Color units on the transparency and print were identified according to vegetation types using NASA air photos, U.S. Forest Service air photos, and experience of the investigator. Five more or less pure colors were identified and associated with vegetation types. These colors were designated according to their appearances on the print: (1) orange for forest vegetation dominated by broad-leaved trees; (2) gray for forest vegetation dominated by needle-leaved trees; (3) violet for scrub vegetation; (4) light violet denoting herbaceous tundra vegetation; and (5) dull violet for muskeg vegetation. This study has shown, through close examinations of the NASA transparency, that much more detailed vegetation landscape, or ecosystem maps could be produced, if only spectral signatures could be consistently and reliably recognized and transferred to a map of suitable scale.

N73-24412*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THREE-D MULTILATERATION: A PRECISION GEODETIC MEASUREMENT SYSTEM
P. R. Escobal, K. M. Ong, O. H. VonRoos, M. S. Shumate, R. M. Jaffe, H. F. Fliegel, and P. M. Muller 15 Mar. 1973 316 p
refs
(Contract NAS7-100)
(NASA-CR-132251; JPL-TM-33-605) Avail: NTIS HC \$18.00 CSCL 08E

A technique of satellite geodesy for determining the relative three dimensional coordinates of ground stations within one centimeter over baselines of 20 to 10,000 kilometers is discussed. The system is referred to as 3-D Multilateration and has applications in earthquake hazard assessment, precision surveying, plate tectonics, and orbital mechanics. The accuracy is obtained by using pulsed lasers to obtain simultaneous slant ranges between several ground stations and a moving retroreflector with known trajectory for aiming the lasers. Author

N73-25341*# Itek Corp., Lexington, Mass. Optical Systems Div.
AUTOMATED THEMATIC MAPPING AND CHANGE DETECTION OF ERTS-A IMAGES Progress Report, 31 Mar. - 31 May 1973
Nicholas Gramenopoulos, Principal Investigator Jun. 1973 7 p
ERTS
(Contract NAS5-21766)
(E73-10644; NASA-CR-132103) Avail: NTIS HC \$3.00 CSCL 08B

N73-25347*# Geological Survey, Washington, D.C.
THE CARTOGRAPHIC APPLICATION OF ERTS/RBV IMAGERY IN POLAR REGIONS Progress Report, 1 Mar. - 30 Apr. 1973

William R. MacDonald, Principal Investigator 1 May 1973
26 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(NASA Order S-70243-AG-2)
(E73-10651; NASA-CR-132242) Avail: NTIS HC \$3.50 CSCL 08B

The author has identified the following significant results. Experiments have demonstrated the feasibility of revising coastlines on maps of Antarctica, detected gross changes in the northern limits of the three largest ice shelves in the world, and led to the discovery of uncharted mountain ranges. A strip photomosaic compiled at a scale of 1:1,000,000 along the Victoria Land Coast between Cape Adare and Harbord Glacier shows obvious changes in size, shape, and position of such features as glaciers, ice tongues, ice shelves, and fast ice. Similar changes to features in the Thwaites Glacier Tongue area were also discovered. Comparison of existing maps and photographs with ERTS-1 imagery over portions of the Ross and Filchner-Ronne Ice Shelves reveals that their northern limits have advanced about 6 and 15 km respectively in 7 years. Imagery also revealed new and unmapped geographical features, of which some are mountains, in the area of the recently published Australian 1:1,000,000 IMW sheet SS 40-42 and USGS IMW sheet ST 57-60 which is presently in final stages of compilation. Comparison of one ERTS-1 scene with a recently published USGS map disclosed a unique change in the Erebus Glacier Tongue. Indications are that its present position is about the same as it was in 1910.

N73-25357*# Tennessee Univ., Knoxville. Dept. of Geography.
GEOGRAPHIC ANALYSIS OF LANDSCAPE CHANGE FROM ERTS-1 IMAGERY Progress Report
John B. Rehder, Principal Investigator Jun. 1973 26 p ref
Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(Contract NAS5-21726)
(E73-10661; NASA-CR-132170) Avail: NTIS HC \$3.50 CSCL 08F

N73-25366*# Battelle Columbus Labs., Ohio.
CALIBRATION AND EVALUATION OF SKYLAB ALTIMETRY FOR GEODETIC DETERMINATION OF THE GEOID Progress Report, 1-31 May 1973
A. George Mourad, Principal Investigator 13 Jun. 1973 3 p
ERE
(Contract NAS9-13276)
(E73-10671; NASA-CR-132182; PR-3) Avail: NTIS HC \$3.00 CSCL 08E

N73-25397*# Earth Satellite Corp., Berkeley, Calif.
PLAN FOR THE UNIFORM MAPPING OF EARTH RESOURCES AND ENVIRONMENTAL COMPLEXES FROM SKYLAB IMAGERY Monthly Progress Report
Charles E. Poulton, Principal Investigator 31 May 1973 3 p
ERE
(Contract NAS9-13286)
(E73-10706; NASA-CR-133019) Avail: NTIS HC \$3.00 CSCL 08B

N73-25418*# Scientific Translation Service, Santa Barbara, Calif.
PLOTTING, ADJUSTMENT AND ESTIMATION OF THE ACCURACY OF SPACE GEODETIC NETWORKS
Ye. G. Boyko, B. M. Klenitskiy, I. M. Landis, and G. A. Ustinov Washington NASA May 1973 315 p refs Transl. into ENGLISH of the book "Postroyeniye, Uravnivaniye i Otsenka Tochnosti Kosmicheskikh Geodezicheskikh Setey" Moscow, Nedra Press, 1972 p 1-208
(Contract NASw-2483)
(NASA-TT-F-776) Avail: NTIS HC \$6.00 CSCL 08E

The problems of designing, mathematically processing, and determining the accuracy of three-dimensional geodetic nets compiled from synchronous observations of artificial earth satellites

are examined. Brief historical information is presented, and the main methods of space triangulation from photographic, laser, and Doppler measurements are described. The a priori determination of the accuracy of elementary figures, series, and continuous nets of space triangulation is discussed. Author

N73-26317* Geological Survey, Denver, Colo.
A STUDY OF MORPHOLOGY, PROVENANCE, AND MOVEMENT OF DESERT SAND SEAS IN AFRICA, ASIA, AND AUSTRALIA Progress Report, 1 May - 30 Jun. 1973
 Edwin D. McKee, Carol S. Breed (Geol. Surv., Flagstaff, Ariz.), and Lawrence F. Harris, Principal Investigators (Geol. Surv., Flagstaff, Ariz.) 1 Jul. 1973 5 p ERTS
 (NASA Order S-70243-AG-4)
 (E73-10710; NASA-CR-133061) Avail: NTIS HC \$3.00 CSCL 08M

The author has identified the following significant results. Examination of sand samples from both dune and interdune areas at White Sands, New Mexico, indicates marked differences in composition and texture between these two types of facies. If these differences are characteristics of dune fields in general, information concerning them may help to explain the contrast in appearance of the two kinds of sand areas on ERTS imagery and to permit interpretation of similar features in remote areas, such as Saudi Arabia.

N73-26345* Experimental Cartography Unit, London (England).
CARTOGRAPHIC EVALUATION OF ERTS-1 IMAGERY FOR PART OF THE UNITED KINGDOM Semiannual Report, Dec. 1972 - May 1973
 D. P. Bickmore, Principal Investigator and W. P. Smith (Fairley Surv. Ltd.) Jun. 1973 20 p refs Sponsored by NASA and Dept. of Trade and Ind., London ERTS
 (E73-10739; NASA-CR-133083) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. The area around Bristol, England contained a variety of both natural and man-made features visible on ERTS imagery, notably the Seven Estuary, the Jurassic limestones of the Cotswold scarp, and a variety of major and minor communications routes and urban developments. Visual interpretive studies were carried out on the diapositive imagery in order to ascertain the extent to which various terrain features, broadly classified into Solid and Drift Geology, Topography, and Land use, were depicted on the four independent imagery bands. Quantitative assessment of the accuracy of map content suggests that the imagery is inadequate for most mapping purposes within the area of study, at least using traditional interpretation methods.

N73-26377* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
CONTRIBUTIONS TO NATIONAL GEODETIC SATELLITE PROGRAM: GLOBAL CORRELATIONS
 M. A. Khan Jun. 1973 11 p refs Submitted for publication (NASA-TM-X-86274; X-592-73-174) Avail: NTIS HC \$3.00 CSCL 08E

Various forms of geophysical information as indicators of the physical properties of the planet are studied. It is useful to study the interrelationships of these various geophysical parameters in an attempt to determine whether they are generated by the same mechanism and if not, to assess the association of the various generating mechanisms. The formulas for studying such correlations are summarized. Author

N73-26386* Kanner (Leo) Associates, Redwood City, Calif.
CRITERIA FOR OPTICAL CLASSIFICATION OF LANDSCAPES
 Yu. S. Tolchelnikov and T. M. Khazanova Washington NASA Jun. 1973 10 p refs Transl. into ENGLISH from "Kriterii Opticheskoy Klassifikatsii Landshtafrov" Moscow Presented at the meeting of the Soviet-American Working Group on Remote Sensing of Natural Environment from Space, 12-17 Feb. 1973 (Contract NASw-2481)
 (NASA-TT-F-14970) Avail: NTIS HC \$3.00 CSCL 08F

A set of quantitative criteria was developed that can be used for the classification of landscapes into taxonomic groups on the basis of their optical properties. The classification is based on the following morphological properties of elements in the landscape: color, dimension and form, texture. Some of the parameters used to characterize the optical properties of elements in the landscape are the mean coefficient of brightness, a parameter characterizing the angular distribution of reflectance, and the mean dimension of components making up an element. The criteria presented can be used to develop a concrete scheme for the optical classification of landscapes with the aid of remote sensing methods. Author

N73-26388* Scientific Translation Service, Santa Barbara, Calif.
STUDY OF THE LANDSCAPE STRUCTURE OF THE EARTH'S STRUCTURE ON THE BASIS OF SPACE PHOTOGRAPHY
 V. A. Nikolayev Washington NASA Jun. 1973 11 p Transl. into ENGLISH of "Izucheniye Landshtafnoy Struktury Zemnoy Poverkhnosti po Materialam Kosmicheskoy Fotossemki", Acad. of Sci. USSR, Inst. of Space Res., Moscow, report, 1973 12 p Presented at Meeting of the Soviet-Am. Working Group on Remote Sensing of Nat. Environment from Space, Moscow, 12-17 Feb. 1973

(Contract NASw-2483)
 (NASA-TT-F-14968) Avail: NTIS HC \$3.00 CSCL 08E
 The advantages of space photography over regular aerial photography are pointed out. They include the ability to integrate small details of the morphological structure of the landscape, while showing its main structural features. The conclusion is reached that space photographs have provided proof of the fractional differentiation of the landscape and the objective existence of landscapes and other natural geosystems. Author

N73-26392* Scripta Technica, Inc., Washington, D.C.
SMALL-SCALE GEOBOTANICAL ZONING AND CARTOGRAPHY BASED ON SPACE PHOTOGRAPHY OF THE EARTH
 B. V. Vinogradov NASA Washington Jul. 1973 25 p refs Transl. into ENGLISH from the publ. "Geobotanicheskoye Kartografirovaniye" Moscow, Nauka, 1971, p 3-18 (Contract NASw-2484)
 (NASA-TT-F-14976) Avail: NTIS HC \$3.25 CSCL 08B

Space photography is discussed as a new and prospective science for use in geobotanical mapping. Emphasis is placed on the fact that this field has received little study. Using predominantly American data, several examples of geobotanical mapping are provided, with an interpretation. Author

N73-27234* Service de la Carte de la Végétation CNRS, Toulouse (France).
MANAGEMENT OF NATURAL RESOURCES THROUGH AUTOMATIC CARTOGRAPHIC INVENTORY Progress Report, Aug. 1972 - Jan. 1973
 Paul-Augustin Rey, Yves Gourinard, and Francis Cambou, Principal Investigators May 1973 80 p refs Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
 (E73-10725; NASA-CR-133069) Avail: NTIS HC \$6.00 CSCL 08B

The author has identified the following significant results. Significant results of the ARNICA program from August 1972 - January 1973 have been: (1) establishment of image to object correspondence codes for all types of soil use and forestry in northern Spain; (2) establishment of a transfer procedure between qualitative (remote identification and remote interpretation) and quantitative (numerization, storage, automatic statistical cartography) use of images; (3) organization of microdensitometric data processing and automatic cartography software; and (4) development of a system for measuring reflectance simultaneous with imagery.

N73-27262* Geological Survey, Denver, Colo.
A STUDY OF MORPHOLOGY, PROVENANCE, AND MOVEMENT OF DESERT SAND SEAS IN AFRICA, ASIA,

03 GEODESY AND CARTOGRAPHY

AND AUSTRALIA Progress Report, 1 Jan. - 30 Jun. 1973
Edwin D. McKee, Carol S. Breed, and Lawrence F. Harris, Principal Investigators 1 Jul. 1973 6 p refs ERTS
(NASA Order S-70243-AG-4)
(E73-10786; NASA-CR-133153) Avail: NTIS HC \$3.00 CSCL 08M

The author has identified the following significant results. The assembling of photomosaics from color prints of ERTS images has made possible the recognition and description of sand patterns, and these are to be the basis of a worldwide classification of sand bodies. Progress has been as rapid as the acquisition of the bulk composite images will permit and for some areas the mosaics are now nearly complete. A second step, which consists of the accumulation and analysis of regional wind data, to be plotted as overlays for the dune patterns, is now underway and should soon give tangible results. Other aspects of the project include the gathering of ground truth in the form of air photographs, needed to interpret geomorphic forms and the sampling of sand deposits for analyzing the texture and composition of sand bodies. A start has been made on these studies in several selected areas.

N73-27292# Hunting Surveys, Ltd., Boreham Wood (England).

STUDY OF TECHNIQUES AND APPLICATIONS OF SATELLITE IMAGERY TO SMALL SCALE MAPPING Progress Report, Jul. 1972 - Jul. 1973

P. G. Mott, Principal Investigator Jul. 1973 7 p Sponsored by NASA ERTS
(E73-10817; NASA-CR-133311) Avail: NTIS HC \$3.00 CSCL 08B

N73-27310# Techtron Corp., Glen Burnie, Md.
SPACE METHODS IN GEOGRAPHY

B. V. Vinogradov Washington NASA Jul. 1973 18 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Geogr. (Moscow), no. 3, 1972 p 78-88
(Contract NASw-2486)
(NASA-TT-F-14973) Avail: NTIS HC \$3.00 CSCL 08F

Remote environment monitoring methods and equipment are discussed. Emphasis is placed on space techniques. Combined interpretation of space images of the earth is described. Cartography of natural formation, investigation of the dynamics and rhythm of the geosphere, and space geo-information systems are discussed. Author

N73-20210# Alaska Univ., Fairbanks.
VEGETATIVE AND GEOLOGIC MAPPING OF THE WESTERN SEWARD PENINSULA, ALASKA, BASED ON ERTS-1 IMAGERY

Jamoe H. Anderson, Louis Shapiro, and Albert E. Belon /in NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 67-72 refs ERTS
(Paper-A8)

ERTS-1 scene 1009-22095 (Western Seward Peninsula, Alaska) has been studied, partly as a training exercise, to evaluate whether direct visual examination of individual and custom color-composite prints can provide new information on the vegetation and geology of this relatively well known area of Alaska. The vegetation analysis reveals seven major vegetation types, only four of which are described on existing vegetation maps. In addition, the ERTS analysis provides greater detail than the existing maps on the areal distribution of vegetation types. The geologic analysis demonstrates that most of the major rock units and geomorphic boundaries shown on the available geologic maps could also be identified on the ERTS data. Several major high-angle faults were observed, but the zones of thrust faults which are much less obvious. Author

N73-20230# Geological Survey, Denver, Colo.
APPLICATION OF ERTS-1 MULTISPECTRAL IMAGERY TO MONITORING THE PRESENT EPISODE OF ACCELERATED EROSION IN SOUTHERN ARIZONA

Roger B. Morrison and Maurice E. Cooley /in NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 283-290 ERTS

(Paper-G7) CSCL 08M

An episode of accelerated arroyo-cutting and sheet erosion commenced about 1890 in southern Arizona, following several thousand years of generally sluggish erosion. For a 17,000-square-mile study area, ERTS-1 images, supplemented by ultrahigh-altitude (U-2 and RB-57) airphotos, are proving effective for producing the first comprehensive maps showing the distribution and seriousness of the post-1890 erosion features, for monitoring now erosion changes, and for assessing the effectiveness of ameliorative measures. Such data are essential for understanding and controlling the accelerated erosion, a key environmental problem in this region. Author

N73-20230# Geological Survey, Denver, Colo.
A STUDY OF MORPHOLOGY, PROVENANCE, AND MOVEMENT OF DEBERT SAND BEACH IN AFRICA, ASIA, AND AUSTRALIA

Edwin D. McKee and Carol S. Breed /in NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 291-303 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(Paper-G8) CSCL 08M

A description and classification of major types of sand coasts on the basis of morphological pattern and location are discussed. The steps involved in analyzing the patterns of deposits on ERTS-1 imagery, where the visible forms are mostly dune complexes rather than individual dunes are outlined. After completion of thematic maps portraying the pattern and location of the sand bodies, data on directions and intensity of prevailing and other winds are plotted on corresponding bases, as a preliminary to determination of internal structures through ground truth.

Author

N73-20271# American Univ., Washington, D.C. Dept. of Biology.

MAPPING ATLANTIC COASTAL MARSHLANDS, MARYLAND, GEORGIA, USING ERTS-1 IMAGERY

Richard R. Anderson, Virginia Carter, and John McGinness /in NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 603-613 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-E7) CSCL 08H

Eastern coastal marshes are the most extensive and productive in the United States. A relatively low cost, moderately accurate method is needed to map these areas for management and protection. Ground-based and low-altitude aircraft methods for mapping are time-consuming and quite expensive. The launch of NASA's Earth Resources Technology Satellite has provided an opportunity to test the feasibility of mapping wetlands using small scale imagery. The test sites selected were in Chesapeake Bay, Maryland, and Osage Bay Island, Georgia. Results of the investigation indicate that the following may be ascertained from ERTS imagery, enlarged to 1:250,000: (1) upper wetland boundary; (2) drainage pattern in the wetland; (3) plant communities; (4) ditching activities associated with agriculture; and (5) lagooning for water-side home development. Conclusions are that ERTS will be an excellent tool for many types of coastal wetland mapping. Author

N73-20268# Geological Survey, Tucson, Ariz.
USE OF THE ORI ELECTRONIC SATELLITE IMAGE ANALYSIS CONSOLE FOR MAPPING SOUTHERN ARIZONA PLANT COMMUNITIES FROM ERTS-1 IMAGERY

Raymond M. Turner /in NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 761-768 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-W7) CSCL 05B

Cloud-free imagery covering the Tucson, Ariz., region for the period from August 22 to November 2, 1972, was used to determine the utility of ERTS-1 data for discriminating boundaries between plant communities. The following studies were made from imagery analyzed by use of an Electronic Satellite Image Analysis Console: (1) console-generated color composites from MSS-5 and MSS-8 bands were recorded photographically from the console color monitor. The color photographs were then used to compare with short-term changes in vegetative cover observed on the ground; (2) using the console, microdensitometric traces were made along selected traverses to quantify changes in scene irradiance across the image field; (3) quantitative plant coverage data, collected at ground-truth stations along the traverses, were compared with the densitometric values. Author

N73-28287* Georgia Univ., Athens.

CARTOGRAPHIC QUALITY OF ERTS-1 IMAGES

R. Welch /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 879-885 refs ERTS

(Grant DI-14-08-0001-13167)

(Paper-L1) CSCL 08B

Analyses of simulated and operational ERTS images have provided initial estimates of resolution, ground resolution, detectability thresholds and other measures of image quality of interest to earth scientists and cartographers. Based on these values, including an approximate ground resolution of 250 meters for both RBV and MSS systems, the ERTS-1 images appear suited to the production and/or revision of planimetric and photo maps of 1:500,000 scale and smaller for which map accuracy standards are compatible with the imaged detail. Thematic mapping, although less constrained by map accuracy standards, will be influenced by measurement thresholds and errors which have yet to be accurately determined for ERTS images. This study also indicates the desirability of establishing a quantitative relationship between image quality values and map products which will permit both engineers and cartographers/earth scientists to contribute to the design requirements of future satellite imaging systems. Author

N73-28288* Geological Survey, McLean, Va.

PROGRESS IN CARTOGRAPHY, EROS PROGRAM

Alden P. Colvocoresses and Robert B. McEwen /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 887-898 refs ERTS

(Paper-L2) CSCL 08B

During the past 7 years the Interior Department EROS (Earth Resources Observation Systems) program with NASA sponsorship has conducted cartographic research based on high altitude aerial and space photographs. The research has centered on the direct use of the image and its transformation into so-called photo or image maps. Today the cartographers of the Geological Survey have a real opportunity for making maps from data supplied by ERTS-1 which is dedicated to remote sensing of the earth. Author

N73-28306* Tennessee Univ., Knoxville. Dept. of Geography. GEOGRAPHIC APPLICATIONS OF ERTS-1 DATA TO LANDSCAPE CHANGE

John B. Rehder /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 955-963 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-L10) CSCL 08F

The analysis of landscape change requires large area coverage on a periodic basis in order to analyze aggregate changes over an extended period of time. To date, only the ERTS program can provide this capability. Three avenues of experimentation and analysis are being used in the investigation: (1) a multi-scale sampling procedure utilizing aircraft imagery for ground truth

and control; (2) a densitometric and computer analytical experiment for the analysis of gray tone signatures, comparisons and ultimately for landscape change detection and monitoring; and (3) an ERTS image enhancement procedure for the detection and analysis of photomorphologic regions. Author

N73-28322* Environmental Research Inst. of Michigan, Ann Arbor.

TERRAIN CLASSIFICATION MAPS OF YELLOWSTONE NATIONAL PARK

Frederick J. Thomson and N. E. G. Roller /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1091-1095 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (Paper-L27) CSCL 08B

A cooperative ERTS-1 investigation involving U. S. Geological Survey, National Park Service, and Environmental Research Institute of Michigan (ERIM) personnel has as its goal the preparation of terrain classification maps for the entire Yellowstone National Park. Excellent coverage of the park was obtained on 6 August 1972 (frame 1015-17404). Preliminary terrain classification maps have been prepared at ERIM by applying multispectral pattern recognition techniques to ERTS-MSS digital taped data. The color coded terrain maps are presented and discussed. The discussion includes qualitative and quantitative accuracy estimates and discussion of processing techniques. Author

N73-28421*# Tennessee Univ., Knoxville. Dept. of Geography.

APPLICATIONS OF ERTS-1 DATA TO LANDSCAPE CHANGE IN EASTERN TENNESSEE

John B. Rehder, Principal Investigator 31 Jul. 1973 13 p refs Proposed for presentation at Symp. on Management and Utilization of Remote Sensing Data, Sioux Falls, S. D., 29 Oct. - 2 Nov. 1973; sponsored by Am. Soc. of Photogrammetry Submitted for publication Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (Contract NAS5-21726) (E73-10843; NASA-CR-133422) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. The analysis of landscape change in eastern Tennessee from ERTS-1 data is being derived from three avenues of experimentation and analysis: (1) a multi-stage sampling procedure utilizing ground and aircraft imagery for ground truth and control; (2) a densitometric and computer analytical experiment for the analysis of gray tone signatures and comparisons for landscape change detection and monitoring; and (3) an ERTS image enhancement procedure for the detection and analysis of photomorphologic regions. Significant results include: maps of strip mining changes and forest inventory, watershed identification and delimitation, and agricultural regions derived from spring plowing patterns appearing on the ERTS-1 imagery.

N73-28426*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

MULTISPECTRAL ANALYSIS OF SURFACE FEATURES IN THE STUDY OF THE EVOLUTION OF BARRIER ISLANDS

N. H. MacLeod, Principal Investigator (Am. Univ., Washington, D. C.), J. Schubert (Am. Univ., Washington, D. C.), and A. Anderson [1973] 1 p ERTS (E73-10848; NASA-TM-X-69368) Avail: NTIS HC \$3.00 CSCL 08F

N73-28440*# Scientific Translation Service, Ann Arbor, Mich. AEROMETHODS OF GEOGRAPHICAL RESEARCH

L. A. Bogomolov, ed. and E. M. Pospelov, ed. Washington NASA Jul. 1973 54 p refs Transl. into ENGLISH of the publ. "Aerometody Geograficheskikh Issledovaniy" Moscow,

03 GEODESY AND CARTOGRAPHY

Geograph. Soc. of the USSR, 1972 p 1-39

(Contract NASw-2483)

(NASA-TT-F-14966) Avail: NTIS HC \$4.75 CSCL 08E

Thirteen papers on aerospace photographic methods, presented at the Moscow Branch of the Geographic Society in 1970-1972, are presented. The topics include: exchange of experience, appropriate scientific research, literature surveys on foreign aerial and space surveys, reports on foreign meetings, applications to agriculture, and geology photogrammetry. Author

N73-29223* Battelle Columbus Labs., Ohio.

CALIBRATION AND EVALUATION OF SKYLAB ALTIMETRY FOR GEODETIC DETERMINATION OF THE GEOID Progress Report, 1-31 Jul. 1973

A. George Mourad, Principal Investigator 10 Aug. 1973 4 p refs EREP

(Contract NAS9-13276)

(E73-10872; NASA-CR-133385; PR-5) Avail: NTIS HC \$3.00 CSCL 08E

N73-29227* Battelle Columbus Labs., Ohio.

CALIBRATION AND EVALUATION OF SKYLAB ALTIMETRY FOR GEODETIC DETERMINATION OF THE GEOID Progress Report, 1-30 Jun. 1973

A. George Mourad, Principal Investigator 9 Jul. 1973 2 p EREP

(Contract NAS9-13276)

(E73-10876; NASA-CR-133493; PR-4) Avail: NTIS HC \$3.00 CSCL 09B

N73-29236* Earth Satellite Corp., Berkeley, Calif.

PLAN FOR THE UNIFORM MAPPING OF EARTH RESOURCES AND ENVIRONMENTAL COMPLEXES FROM SKYLAB IMAGERY Monthly Progress Report, 1-31 Jul. 1973

Charles E. Poulton, Principal Investigator 21 Aug. 1973 8 p EREP

(Contract NAS9-13286)

(E73-10888; NASA-CR-133523; MPR-6) Avail: NTIS HC \$3.00 CSCL 02D

N73-29243* Service de la Carte de la Vegetation CNRS, Toulouse (France).

MANAGEMENT OF NATURAL RESOURCES THROUGH AUTOMATIC CARTOGRAPHIC INVENTORY Progress Report, Oct. 1972 - Mar. 1973

Paul-Augustin Rey, Yves Gourinard, and Francis Cambou, Principal Investigators Jun. 1973 33 p refs Sponsored by NASA ERTS

(E73-10894; NASA-CR-133522; PR-2) Avail: NTIS HC \$3.75 CSCL 08B

The author has identified the following significant results. Over those parts of the ARNICA test site where ERTS-1 data were available, the search for correspondences between images and ground truth acquired by the vegetation and geology maps was quite positive. The probability of recognition of soil use types can be estimated at: (1) 100% for water plans, rivers, canals, swamplands, and wetlands; (2) 80%-100% for the major types of forestry, farmland zones, moorlands and pasturelands, and urbanization; (3) 20%-50% for communication lines; (4) 60%-80% for forestry species and organization of agricultural areas; (5) 40%-60% for finer discrimination between forest types and more accurate identification of cultivations; (6) 80%-90% for major geological features. These percentages will be improved upon as soon as it is possible to use the repetitive imagery. An early use of automatic cartography using ERTS-1 imagery was made possible for pine forests in the Central Pyrenees, the densitometric signature of which were particularly significant. Important observations were made in related fields of water resources, snow survey, estuary dynamics, and meteorology.

N73-29265* Earth Satellite Corp., Berkeley, Calif.

PLAN FOR THE UNIFORM MAPPING OF EARTH RESOURCES AND ENVIRONMENTAL COMPLEXES FROM SKYLAB IMAGERY Monthly Progress Report, 1-30 Jun. 1973

Charles E. Poulton, Principal Investigator 30 Jun. 1973 4 p EREP

(Contract NAS9-13286)

(E73-10916; NASA-CR-133573; MPR-5) Avail: NTIS HC \$3.00 CSCL 08B

N73-29270* Alaska Univ., Fairbanks. Inst. of Arctic Biology. **IDENTIFICATION, DEFINITION AND MAPPING OF TERRESTRIAL ECOSYSTEMS IN INTERIOR ALASKA** Semiannual Technical Report, Feb. - Jul. 1973

J. H. Anderson, Principal Investigator 31 Jul. 1973 26 p refs ERTS

(Contract NAS5-21833)

(E73-10921; NASA-CR-133578; SATR-2) Avail: NTIS HC \$3.50 CSCL 08B

The author has identified the following significant results. The primary objective is to identify and analyze vegetation types in as great of detail as possible on ERTS-1 imagery and to classify and delineate them through mapping. This is basic to the identification, definition, and mapping of ecosystems. Major conclusions are: (1) the ERTS-1 system is useful for regional scale studies of broadly defined Alaskan vegetation types; (2) the resolution and spectral capabilities of ERTS-1 MSS imagery in photographic formats is adequate for certain phytocenologic purposes; and (3) preparation of an improved State vegetation map will be feasible.

N73-29413 South Dakota State Univ., Brookings.

RECOGNIZABILITY AND REPRODUCIBILITY OF AIRPHOTO INTERPRETED LANDSCAPE UNITS Ph.D. Thesis

Robert Dean Heil 1972 112 p

Avail: Univ. Microfilms Order No. 73-5813

A physiographic terrain analysis study using the principles of airphoto interpretation was made: (1) to determine the internal homogeneity of airphoto interpreted mapping units, (2) to determine the variability in characteristics among different occurrences of the same mapping unit, and (3) to determine if the units differentiated were sufficiently different to warrant discrimination. The study was conducted in Sedgewick County, Colorado. The study area was comprised of four distinctly different land forms: a major river and its associated floodplain and terraces; a level to nearly level loamy upland plain; a level to sloping sandy upland plain; and steeply sloping, sandy and gravelly rough broken lands. From this study it was concluded that airphoto interpretation was successful for delineating landscape units that are sufficiently homogeneous with respect to parent material, slope, soil drainage class, soil depth, range site group and land capability classification to have predictive value for moderately extensive land use. Dissert. Abstr.

N73-30294* Geological Survey, Washington, D.C.

INVESTIGATION OF ERTS-A IMAGES FOR APPLICATION TO THEMATIC MAPPING Progress Report, 1 Jan. - 30 Jun. 1973

Dean T. Edson, Principal Investigator and Doyle G. Smith 1 Jul. 1973 5 p ERTS

(NASA Order S-70243-AG)

(E73-10952; NASA-CR-133628) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. Theme extractions, enlarged to proper scale can prove a simple and convenient tool for evaluation of small scale map content, and as a guide to and for map revision. Open water extractions provide a graphic, easy to read, historical documentation of the recent Mississippi River flood at successive times during the flood period. Open water extractions, used in conjunction with swamp/wetland extractions, can be used to document and monitor temporal changes in wetland water levels.

N73-30295* Geological Survey, Washington, D.C.

THE CARTOGRAPHIC APPLICATION OF ERTS/RBV IMAGERY IN POLAR REGIONS Progress Report, 1 Jan. - 30 Jun. 1973

William R. MacDonald, Principal Investigator 1 Jul. 1973 5 p ERTS

(NASA Order S-70243-AG-2)
(E73-10953; NASA-CR-133629) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. Results of the SR-149 experiments demonstrated the feasibility of revising coastlines on maps of Antarctica, detected gross changes in the northern limits of the three largest ice shelves in the world, and led to the discovery of unmapped geographical features in Antarctica. Analyses of MSS imagery during the investigations show positive identification and obvious changes in size, shape, and position of such features as glaciers, ice tongues, ice shelves, and fast ice when compared to the existing USGS 1:250,000 scale maps. Investigations also pointed out that accurate and meaningful photoimage mosaics can be compiled at scales of 1:500,000 and 1:1,000,000 over the Polar Regions. With respect to the Antarctic region, many thousands of square miles can be image mapped for the very first time if cloud-free imagery becomes available and at a great reduction in cost of compilation. The international scientific community will benefit from such timely products. Current maps are a necessity for proper planning for field operations, especially over the treacherous terrain of the Antarctic.

N73-30299* Geological Survey, McLean, Va.
OVERALL EVALUATION OF ERTS-1 IMAGERY FOR CARTOGRAPHIC APPLICATION Progress Report, 1 Jan. - 1 Aug. 1973

Alden P. Colvocoresses, Principal Investigator Aug. 1973 51 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (NASA Order S-70243-AG-2) (E73-10957; NASA-CR-133633) Avail: NTIS HC \$4.75 CSCL 08B

The author has identified the following significant results. Scientific results may be summarized as follows: (1) A geodetic (UTM) grid can be fitted to MSS bulk images with a positional accuracy in the order of 50 meters (rms). (2) The MSS imagery as corrected and printed in bulk form is in effect or a defined map projection. This projection, if optimized for cartographic presentation, will have distortions in the order of only 1 part in 10,000. (3) The orbit of ERTS-1 and image delineation of MSS imagery can be held by NASA so that predesignated scenes may be identified and used as a basis for a map series. This concept could reduce the time and cost of ERTS-1 image map production many fold as compared to standard quadrangle format production.

N73-30381* Naval Weapons Lab., Dahlgren, Va.
POLE POSITION FOR 1972 BASED ON DOPPLER SATELLITE OBSERVATIONS

Richard J. Anderle May 1973 83 p refs (AD-763362; NWL-TR-2952) Avail: NTIS CSCL 08/5

The position of the earth's spin axis with respect to the crust was computed on the basis of Doppler satellite observations in 1972 for the fourth consecutive year. The standard error of the determination based on five days of observations was as low as 20 cm during periods when data from 19 stations on three satellites were used in computations. In addition, computation of satellite orbits was performed for isolated time spans dating back to 1964, and changes in latitude residuals were computed for each station for the period 1964-1972; the changes were consistent with the standard error of 10-20 cm/year. Author (GRA)

N73-31286* Earth Satellite Corp., Berkeley, Calif.
PLAN FOR THE UNIFORM MAPPING OF EARTH RESOURCES AND ENVIRONMENTAL COMPLEXES FROM SKYLAB IMAGERY Monthly Progress Report, 1-31 Aug. 1973

Charles E. Poulton, Principal Investigator 10 Sep. 1973 8 p EREP (Contract NAS9-13286) (E73-10979; NASA-CR-133758; MPR-7) Avail: NTIS HC \$3.00 CSCL 08B

N73-31300* National Ocean Survey, Rockville, Md.
SKYLAB A PROPOSAL AEROTRIANGULATION WITH VERY SMALL SCALE PHOTOGRAPHY Quarterly Report, 15 Apr. - 15 Jul. 1973
Morton Keller, Principal Investigator 15 Jul. 1973 1 p EREP (NASA Order T-4110-B) (E73-10994; NASA-CR-133775) Avail: NTIS HC \$3.00 CSCL 14E

N73-31301* National Ocean Survey, Rockville, Md.
SKYLAB A PROPOSAL AEROTRIANGULATION WITH VERY SMALL SCALE PHOTOGRAPHY Quarterly Report, 15 Jan. - 15 Apr. 1973
Morton Keller, Principal Investigator 15 Apr. 1973 1 p EREP (NASA Order T-4110-B) (E73-10995; NASA-CR-133776) Avail: NTIS HC \$3.00 CSCL 14E

N73-31318* Battelle Columbus Labs., Ohio.
CALIBRATION AND EVALUATION OF SKYLAB ALTIMETRY FOR GEODETIC DETERMINATION OF THE GEOID Progress Report, 1-31 Aug. 1973
A. G. Mourad and D. M. Fubara, Principal Investigators 17 Sep. 1973 9 p refs EREP (Contract NAS9-13276) (E73-11013; NASA-CR-133806; PR-6) Avail: NTIS HC \$3.00 CSCL 08E

N73-31384* Geological Survey, Washington, D.C. Topographic Div.
RESEARCH AND DEVELOPMENT IN TOPOGRAPHIC MAPPING Annual Report, 1973
Apr. 1973 72 p refs (PB-221469; USGS-TD-73-001) Avail: NTIS HC \$4.50 CSCL 08B

The annual report, covering the 12-month period ending in April 1973, summarizes the research and development activities of the U. S. Geological Survey, Topographic Division in the Office of Research and Technical Standards and in the Region offices at Arlington, Va., Rolla, Mo., Denver, Colo., and Menlo Park, Calif. The R and D projects mentioned concern the fields of cartography, field surveys, photogrammetry, orthophotomapping, and space technology. Articles by Division personnel prepared for presentation at meetings and conferences or for publication in professional journals and the Manual of Topographic Instructions are also listed. GRA

N73-31901* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
POLAR MAPPING WITH ERTS-1
James R. Greaves In its Significant Accomplishments in Sci. 1973 p 178-181 CSCL 08B

N73-32241* Alaska Univ., Fairbanks.
IDENTIFICATION, DEFINITION AND MAPPING OF TERRESTRIAL ECOSYSTEMS IN INTERIOR ALASKA Bimonthly Progress Report
J. H. Anderson, Principal Investigator 30 Sep. 1973 8 p ERTS (Contract NAS5-21833) (E73-11065; NASA-CR-135521; BMPR-7) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. Two new, as yet unfinished vegetation maps are presented. These tend further to substantiate the belief that ERTS-1 imagery is a valuable mapping tool. Newly selected scenes show that vegetation interpretations can be refined through use of non-growing season imagery, particularly through the different spectral characteristics of vegetation lacking foliage and through the effect of vegetation structure on apparent snow cover. Scenes now are available for all test area north of the Alaska Range except Mt. McKinley National Park. No support was obtained

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for the hypothesis that similar interband ratios, from two areas apparently different spectrally because of different sun angles, would indicate similar surface features. However, attempts to test this hypothesis have so far been casual.

N73-32246* Earth Satellite Corp., Berkeley, Calif.
A SCHEME FOR THE UNIFORM MAPPING AND MONITORING OF EARTH RESOURCES AND ENVIRONMENTAL COMPLEXES USING ERTS-1 IMAGERY Progress Report, 1 Jul. - 31 Aug. 1973
C. E. Poulton, Principal Investigator 31 Aug. 1973 11 p Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (Contract NAS5-21830)
(E73-11070; NASA-CR-135526; PR-5) Avail: NTIS HC \$3.00 CSCL 08B

N73-32256* Naval Research Lab., Washington, D.C.
TERRAIN PROPERTIES AND TOPOGRAPHY FROM SKYLAB ALTIMETRY Monthly Progress Report, Aug. 1973
Allan Shapiro, Principal Investigator 30 Sep. 1973 1 p EREP
(NASA Order T-4716-B)
(E73-11081; NASA-CR-135550) Avail: NTIS HC \$3.00 CSCL 08E

N73-33237 Ohio State Univ., Columbus.
APPLICATION OF KINEMATICAL GEODESY FOR DETERMINING THE SHORT WAVE LENGTH COMPONENTS OF THE GRAVITY FIELD BY SATELLITE GRADIOMETRY Ph.D. Thesis
George Bruce Reed 1973 173 p
Avail: Univ. Microfilms Order No. 73-18944
Satellite-borne hybrid measuring systems which, in general, provide a capability to sense some spectrum of the earth's gravitational field directly are being developed. Among each such systems currently in an advanced stage of development are satellite gradiometers. A geodesy oriented investigation was carried out to develop a possible procedure for the use of satellite gradient measurements in obtaining gravity boundary values and to determine if gradiometry can provide, with sufficient accuracy, discrete geopotential information equivalent to harmonic degree 90.
Dissert. Abstr.

N73-33238 Ohio State Univ., Columbus.
THE METRIC CARTOGRAPHIC POTENTIAL OF GEOSTATIONARY/GEOSYNCHRONOUS SATELLITES Ph.D. Thesis
Louis Henry Knipling 1973 273 p
Avail: Univ. Microfilms Order No. 73-18916

The metric cartographic potential of a satellite camera orbiting at 35,786 km about the earth was investigated. Major pertinent areas contributing to the determination of this potential were investigated and reported upon. These areas include: the geosynchronous orbit, design requirements of a suitable telescopic space camera, the effects of geophysical phenomena upon the imagery, the imagery sensors, the electronic transmission link, and the accuracy requirements for maps. A photogrammetric data generator based upon the use of highly convergent photography was used to develop 20 cases in which the focal lengths were 15 and 45 meters. It is concluded that the 15 meter focal length system has the capability of acquiring photography to support Class A mapping at a scale of 1:800,000 when no ground control is available and Class A mapping at a scale of 1:35,000 when ground control of 1 meter accuracy is present. The 45 meter camera can support mapping of 1:350,000 Class A when no ground control is present and Class A mapping of scale 1:35,000 when ground control of 1 meter accuracy is introduced into the solution.
Dissert. Abstr.

N73-33240 Illinois Univ., Urbana.
INTERPRETATION OF AEROMAGNETIC OR GRAVITY DATA BY THE METHOD OF DIFFERENCE MAPPING Ph.D. Thesis

Fu-Shyong Ju 1973 200 p
Avail: Univ. Microfilms Order No. 73-17574

An attempt is made to investigate the potential differences between various levels in a Newtonian potential field, to interpret the physical significance of such differences and to explore the possibility of using a difference mapping technique in mineral exploration. Difference fields in consecutive order are obtained from the continuation of a potential field which is known at a certain level. This part of the problem is basically equivalent to solving the Laplace equation subject to a plane boundary condition. To interpret the source of a potential field, in geophysics, it is essential to separate effects of regional and local origin. The method of upward continuation of the potential may be used to eliminate local irregularities of a given gravity or magnetic anomaly field and thus separate the effects due to far and near sources.
Dissert. Abstr.

N73-33275* Battelle Columbus Labs., Ohio.
CALIBRATION AND EVALUATION OF SKYLAB ALTIMETRY FOR GEODETIC DETERMINATION OF THE GEOID Progress Report, 1-30 Sep. 1973
A. G. Mourad and D. M. Fubara, Principal Investigators 12 Oct. 1973 24 p refs EREP
(Contract NAS9-13276)
(E73-11120; NASA-CR-135658; PR-7) Avail: NTIS HC \$3.25 CSCL 05B

N73-33294* Earth Satellite Corp., Washington, D.C.
SAMPLING STRATEGIES IN LAND USE MAPPING USING SKYLAB DATA Monthly Progress Report, Sep. 1973
David S. Simonett, Principal Investigator Sep. 1973 2 p EREP
(Contract NAS9-13314)
(E73-11139; NASA-CR-135690) Avail: NTIS HC \$3.00 CSCL 08B

N73-33303* Earth Satellite Corp., Berkeley, Calif.
PLAN FOR THE UNIFORM MAPPING OF EARTH RESOURCES AND ENVIRONMENTAL COMPLEXES FROM SKYLAB IMAGERY Monthly Progress Report, 1-30 Sep. 1973
Charles E. Poulton, Principal Investigator 30 Sep. 1973 8 p EREP
(Contract NAS9-13286)
(E73-11149; NASA-CR-135737; MPR-8) Avail: NTIS HC \$3.00 CSCL 08B

N73-33315* Geological Survey, Washington, D.C.
INVESTIGATION OF SKYLAB IMAGERY FOR APPLICATION TO THEMATIC MAPPING Quarterly Progress Report, 1 May - 31 Jul. 1973
Doyle G. Smith, Principal Investigator 15 Aug. 1973 2 p EREP
(NASA Order T-4649-B)
(E73-11162; NASA-CR-135756) Avail: NTIS HC \$3.00 CSCL 08B

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GEOLOGY AND MINERAL RESOURCES

Includes mineral deposits, petroleum deposits, spectral properties of rocks, geological exploration, and lithology.

A70-16073

GEOLOGY IN SATELLITE PICTURES (GEOLOGIE AUF SATELLITENBILDERN).

Dieter Bannert (Bundesanstalt für Bodenforschung, Hanover, West Germany).

Naturwissenschaftliche Rundschau, vol. 22, Dec. 1969, p. 517-524. 8 refs. In German.

Review of the potential geological contribution of satellite photography, its limitations, and the scope of its practical applications. The characteristics of satellite photography of foremost interest to the geologist are twofold: (1) the synoptic surveyability of relatively vast areas under uniform observational conditions affords knowledge previously inaccessible to investigators; and (2) the greatly reduced scale makes it possible to obtain geological maps for territories hitherto little known because of their remoteness and the high costs of conventional aerial surveys. These two points are illustrated by numerous photographs and photo-derived geological maps. American and European unmanned geological-survey satellite programs planned for the 1970s are discussed, along with the possible wider significance of satellite photography. M.V.E.

A70-16390

A STATISTICAL ANALYSIS OF THE REFLECTANCE OF IGNEOUS ROCKS FROM 0.2 TO 2.65 MICRONS.

Howard P. Ross, Joel E. M. Adler, and Graham R. Hunt (USAF, Office of Aerospace Research, Cambridge Research Laboratories, Bedford, Mass.).

Icarus, vol. 11, July 1969, p. 46-54. 15 refs.

Reflectance spectra from 0.2 to 2.65 microns were obtained for several igneous rocks and minerals. The reflectance of all the rock samples, when crushed, increases with decreasing particle size. A statistical analysis established the correlation between reflectance and the wavelength of energy, the generalized composition, and the particle size of the rock samples. Most of the absorption bands present in the spectra correspond to some form of water in the sample, or are common to unrelated rocks and minerals, and, therefore, are not diagnostic of composition. A correlation analysis between the generalized composition variable and the ratios of reflectance at two different wavelengths has indicated correlation coefficients as high as 0.88 and may prove useful in selecting the more characterizing regions of the spectrum for remote sensing experiments. (Author)

A70-16498

ON IR IMAGERY AND ITS APPLICATION TO THE MAPPING OF GEOTHERMAL DISTRIBUTIONS.

K. Matsuno, H. Hase, and K. Nishimura (Geological Survey of Japan, Applied Geological Dept., Kawasaki, Japan).

Photogrammetria, vol. 25, Dec. 1969, p. 61-74. 10 refs.

Survey of IR geologic research in Japan, and description of some aspects of further study. Several examples of IR images obtained by means of InSb detectors are given. The images give the approximate thermal distribution of the earth surface investigated. Factors which influence the imagery are outlined. (Author)

A70-16499

GEOLOGICAL INTERPRETATION OF AERIAL PHOTOGRAPHS (ZUR GEOLOGISCHEN AUSWERTUNG VON LUFTBILDERN).

P. Kronberg (Clausthal, Technische Universität, Geologisches Institut, Clausthal-Zellerfeld, West Germany).

Photogrammetria, vol. 25, Dec. 1969, p. 75-85. 8 refs. In German.

Discussion of the basic concepts and methods of photogeology and of the application of these methods to problems of geology. The interpretation of the characteristic features of aerial photographs is examined. Picture quality is considered in relation to the scale and the film material used in photogeology. Applications of photogeological methods to geological mapping, mineral exploration, hydrology and engineering geology are discussed. G.R.

A70-20225

GEOLOGY FROM THE AIR.

J. F. M. Mekel (International Institute for Aerial Survey and Earth Sciences, Delft, Netherlands).

Delft, Uitgeverij Waltman, 1969. 18 p. 19 refs.

The use of aerial and space photography and of sensors based on parts other than the visible part of the electromagnetic spectrum for geological studies is discussed. The transmission of photographs from Moon and Mars is considered. Historical balloon flights are discussed and the development of aerial photography and airphoto-interpretation is described. Examples are given for the application of aerial and satellite photography to geological problems. G.R.

A70-22882

The multiband approach to geological mapping from orbiting satellites—Is it redundant or vital? R. J. P. Lyon (Stanford University, Stanford, Calif.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-303*. 11 p. 19 refs. Members, \$1.00; nonmembers, \$1.50.

Attempt to establish what spectral evidence exists by which rocks may be differentiated, and where in the photographic and IR regions this lies. Several experimental attempts to use spectral information for rock and soil mapping are reviewed. It is pointed out that the simplest and cheapest form of spectral information can be obtained using color films in which the preservation of the geometrical relationships between objects markedly assists the mapping process. We do not yet have experimental evidence that spectral data can provide the required differentiation between materials of geological interest. Physical composition such as soil particle sizes, sand grain size, and rock densities can be assessed with reasonable success, only if repetitive thermal-band measurements can be made. In this way the thermal inertia of the materials can be assessed by determining the rate of change of their radiometric temperatures with solar phase. From orbit, the problem of rock and soil definition is complicated by the varied transmission of the atmosphere, which only allows viewing of the ground through small and restricted windows. M.M.

A70-26933 *

Application of computer processed multispectral data to the discrimination of land collapse (sinkhole) prone areas in Florida. A. E. Coker (U.S. Geological Survey, Tampa, Fla.), R. Marshall, and N. S. Thomson (Michigan University, Ann Arbor, Mich.). In: *International Symposium on Remote Sensing of Environment*, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 1.

Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan University, 1969, p. 65-75, 77. 9 refs. NASA-Army-USAF-sponsored research.

The U.S. Geological Survey and the Infrared and Optics Laboratory of the University of Michigan jointly collected data near Bartow, Florida for the purpose of studying land collapse phenomena using remote sensing techniques. Data obtained using the multispectral scanner system consisted of various combinations of 18 spectral bands ranging from 0.4 to 14.0 microns and several types of photography. Since areas prone to active sink collapse often are not detectable from apparent surface expression of hydrology and geology prior to actual collapse, it was necessary to apply indirect methods to the problem of detecting the surface effects caused by water pressure decline in the areas of active sinkhole development. An experiment was conducted to collect and process data for the

purpose of testing the hypothesis that areas of active sinks could be detected at the land surface from the integrated effects of water loss at depth on vegetation physiology and terrain temperature. The multispectral data were processed on the University of Michigan's special-purpose analog computer in order to detect moisture-stressed vegetation and to enhance terrain surface temperatures. The processed results were printed on film to show the patterns of distribution of the proposed hydrogeologic indicators. Terrain temperature patterns (obtained from processed 8-14 microns data), when compared with moisture-stressed vegetation patterns (obtained from processed 1-2.6 microns data), show distinctive patterns which correlate with areas of known sinkhole activity in the Bartow area. Analyses of National Aeronautics and Space Administration data and field data seem to indicate that the processed data have potential for locating areas of impending land collapse. (Author)

A70-26960 # Pseudo-radar topographic shadowing for detection of sub-continental sized fracture systems. Donald U. Wise (Massachusetts, University, Amherst, Mass.; Franklin and Marshall College, Lancaster, Pa.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 1. Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 603-615. 6 refs. Research supported by the Franklin and Marshall College.

Demonstration that radar imagery of real topography or photos of side-illuminated raised plastic relief maps may enhance many elements of linear topography. This applies particularly to those valleys with strikes at acute angles to the light source so that illumination grazes one of the walls. Dozens to hundreds of topographic linears appear on all relief maps examined with scales from 1:62,500 to 1:1,000,000. They are commonly arranged in six- to eight-strike sets with individual linears persisting for a hundred miles or more, the sets themselves continuing for many hundreds of miles. Complex fracture networks occur with constant orientation over vast areas of North America, Europe, and Iceland, some elements of the networks being correlatable with known fault or fracture systems. The relations suggest tectonic heredity of older systems being propagated upward through youthful covering sediments and/or manifestations of near-modern stress trajectories of constant orientation over areas of at least subcontinental dimensions. A.B.K.

A70-26961 # Recent developments in remote sensing for geophysical applications. A. R. Barringer and J. D. McNeill (Barringer Research, Ltd., Rexdale, Ontario, Canada). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 1. Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 617-636.

Description of two systems, INPUT (Induced Pulse Transient) and Radiophase, which appear to have a high potential for geological mapping in various environments. Radiophase uses the transmissions from the various vlf radio stations located about the world. The vertical electric field is used as a phase reference against which to measure both phase and amplitude variations of the three components of the vlf magnetic field. The techniques used for data acquisition and data reduction are described, and the results of a recent survey over the Precambrian shield in northern Quebec and Ontario are presented. The INPUT system has been in use for many years as a major mineral exploration tool. By virtue of the fact that it is a pulsed system and high frequencies are present, subtle variations in the near-surface conductivity can be effectively mapped, and the presence of layering detected. Some recent theoretical results and a description of some preliminary results in the search for gravels with a twelve-channel INPUT are presented. A.B.K.

A70-26962 * # The influence of radar look-direction on the detection of selected geological features. H. C. MacDonald, J. N. Kirk, L. F. Dellwig, and A. J. Lewis (Kansas, University, Lawrence, Kan.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 1.

Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 637-650. 15 refs. Grant No. DA-AK-02-68-C-0089; Contract No. NAS 9-7175.

Comparison of specific examples of areas of the United States with multiple pass coverage and data obtained from similar coverage over eastern Panama, showing that radar look direction definitely influences the detectability of certain geological features. It is shown that, depending on the relative topographic relief, effective incidence angle, and look direction, geological features can be advantageously enhanced or can be completely suppressed. To obtain the maximum benefit from radar geological reconnaissance studies in poorly mapped areas, it is suggested that a specific region be imaged from four orthogonal look directions. For more detailed studies where a known terrain configuration is to be imaged, a minimum of two opposing look directions will be required for optimum geological interpretation. A.B.K.

A70-27873 Color aerial photos in the reconnaissance of soils and rocks. Abraham Anson (U.S. Army, Engineer Topographic Laboratories, Fort Belvoir, Va.). (American Society of Testing Materials, Annual Meeting, Boston, Mass., Feb. 1968.) *Photogrammetric Engineering*, vol. 36, Apr. 1970, p. 343-347, 349-354. 25 refs.

Discussion of several tests of aerial color photography, the primary purpose of which was to obtain quantitative and qualitative data regarding the role of color, panchromatic black-and-white, and infrared films in photogrammetric application to the extraction of terrain information. The tests include the Eastern Coastal Plain near Bennettsville, South Carolina, and the western desert near Phoenix, Arizona. The capabilities of the aerial color photography in interpreting soils and rocks are compared to those of black-and-white photography, and the superiority of color photographs is demonstrated. O.H.

A70-30641 Linear geological features as an aid to photogeological research. J. W. Norman (Imperial College of Science and Technology, London, England). *Photogrammetria*, vol. 25, Apr. 1970, p. 177-187. 9 refs.

As most photogeological interpretation tends to be of linear features (e.g., faults, rock and soil contacts) it is suggested that these should be exploited for research studies. It is possible to use them to assess the relative performance of various means of sensing, the factors affecting the usefulness of sensors, and to develop interpretation criteria for various instruments and environments. To do this it is necessary to record the characteristics of the appearance of these linear features on the air photographs or imagery, the relevant field data, and situations where features do not show. If the details are recorded for each feature on punched cards, a computer can be used to test large numbers of correlations and permit a useful interchange of data files between researchers working on different problems in different places. It could also form a useful prelude to attempts to create an automatic pattern recognition system. (Author)

A70-37077 * Phase delay of the solid earth tide. Stewart W. Smith and Pierre Jungels (California Institute of Technology, Pasadena, Calif.). *Physics of the Earth and Planetary Interiors*, vol. 2, June 1970, p. 233-238. 19 refs. Grants No. NGL-05-002-069; No. AF AFOSR 62-421.

Analysis of tidal strain data from Isabella, California and Ñaña, Peru, to determine the phase shift of the M sub 2 plus or minus solid tide and the Love number combination (h-3l). The phase advance of the tidal bulge is 3.0 plus or minus 1 deg, and (h-3l) = 0.475. Tidal strain meters appear to be more suitable for such measurements than

de gravimeters. Indirect tidal effects due to ocean and atmosphere loading of the crust are minimized by performing the tidal analysis on the areal dilatation rather than on individual strain components. The lunar retarding torque calculated from this result is $(5.7 \text{ plus or minus } 1.7) \times 10$ to the minus 23rd dyne/cm which is in agreement with the value obtained from discrepancies in the lunar orbit. The tidal effective Q determined in this study is 10, which is entirely controlled by losses in the ocean and atmosphere and has no bearing on the anelasticity of the solid earth. (Author)

A70-43085 # Remote sensing in layered rocks. R. A. Peterson (United Geophysical Corp., Pasadena, Calif.). *Bendix Technical Journal*, vol. 3, Summer-Autumn 1970, p. 1-8. 10 refs.

Description of the nature of the geologic object field, the illumination of the field with seismic waves, the recording or remote sensing of returning reflected and diffracted waves, and the preparation of data for final visual display. Some of the interesting possibilities of improving seismic data display methods are pointed out and discussed. Both the hologram approach for monochromatic illumination and equivalent wave-mapping methods for broad-frequency-band illumination are illustrated. M.V.E.

A71-11493 * Magnetic field fluctuations in the earth's magnetosheath. Donald H. Fairfield and Norman F. Ness (NASA, Goddard Space Flight Center, Laboratory for Extraterrestrial Physics, Greenbelt, Md.). *Journal of Geophysical Research*, vol. 75, Nov. 1, 1970, p. 6050-6060. 26 refs.

Study of magnetic field fluctuations in the sunward hemisphere of the magnetosheath using IMP 4 measurements. Power spectra have been computed in the frequency range below 0.2 Hz in a field-aligned coordinate system which allows the separation of transverse and longitudinal perturbations. Power levels on different passes through the magnetosheath typically vary by an order of magnitude or more, and spectral peaks are frequently seen throughout the frequency range studied. Spatial variations of wave amplitudes are characterized by enhancements of the transverse mode near both the shock and the magnetopause, but these variations tend to be smaller than the day to day variations. The dawn quadrant of the magnetosheath tends to exhibit a somewhat higher level of fluctuations. Transverse waves are often linearly polarized, and they tend to have their disturbance vector aligned with the shock and magnetopause surfaces. Compressional fluctuations tend to be larger than transverse fluctuations at low frequencies, but transverse amplitudes dominate at higher frequencies. M.V.E.

A71-15309 Comments on the geologic use of Nimbus I television photography. George Rabchevsky (Allied Research Associates, Inc., Lanham, Md.). In: Space sciences - Future applications for mankind; Vandenberg Scientific and Technical Societies Council, Western Space Congress, 1st, Santa Maria, Calif., October 27-29, 1970, Proceedings. Part 1. North Hollywood, Calif., Western Periodicals Co., 1970, p. 468-482. 48 refs.

Brief discussion of background geological studies using Nimbus Advanced Vidicon Camera System (AVCS) imagery to illustrate the potential geologic usefulness of such satellite photographs. New geologic applications are discussed keeping in mind that these vidicon systems were designed for meteorological purposes. Two specific examples of the application of Nimbus photographs to geology for regions differing in their bedrock geology, geomorphology and climate, are discussed. Recommendations for further use of Nimbus data are suggested. M.M.

A71-17562 * The multiband approach to geological mapping from orbiting satellites - Is it redundant or vital. R. J. P. Lyon (Stanford University, Stanford, Calif.). (*American Institute of Aeronautics and Astronautics, Earth Resources Observations and*

Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-303.) *Remote Sensing of Environment*, vol. 1, Dec. 1970, p. 237-244. 19 refs. Contract No. NAS 9-7313.

Attempt to establish what spectral evidence exists by which rocks may be differentiated, and where in the photographic and IR regions this lies. Several experimental attempts to use spectral information for rock and soil mapping are reviewed. It is pointed out that the simplest and cheapest form of spectral information can be obtained using color films in which the preservation of the geometrical relationships between objects markedly assists the mapping process. We do not yet have experimental evidence that spectral data can provide the required differentiation between materials of geological interest. Physical composition such as soil particle sizes, sand grain size, and rock densities can be assessed with reasonable success, only if repetitive thermal-band measurements can be made. In this way the thermal inertia of the materials can be assessed by determining the rate of change of their radiometric temperatures with solar phase. From orbit, the problem of rock and soil definition is complicated by the varied transmission of the atmosphere, which only allows viewing of the ground through small and restricted windows. M.M.

A71-19318 # A hypothetical meteorite crater in southeastern Mongolia (Predpolagaemyi meteoritnyi krater v Iugovostochnoi Mongolii). O. D. Suetenko and L. M. Shkerin (Akademiia Nauk SSSR, Geologicheskii Institut, Moscow, USSR). *Astronomicheskii Vestnik*, vol. 4, Oct.-Dec. 1970, p. 261-263. In Russian.

Description of a craterlike feature 1.3 km in diameter located roughly 90 km SE from the town of Sain-Shand in southeastern Mongolia. Observations carried out in the summer of 1968 on the spot and aerial photography suggest that the crater may be a formation unrelated to the geological structure of the site and that it disrupts the natural paleozoic rock layers of the area. It is thought that this eroded crater may have been produced by the impact of a meteorite. Further studies are suggested to determine the origin of the crater with more certainty. V.Z.

A71-23872 Photo interpretation applied to geomorphology - A review. F. Fezer (Heidelberg, Universität, Heidelberg, Germany). *Photogrammetria*, vol. 27, Jan. 1971; p. 7-53. 644 refs.

Methods of recording and interpreting aerial photographs developed since 1960 are examined, which make it possible to recognize a greater variety of landforms. The geomorphological interpretation of structural and volcanic landforms, karst landforms, periglacial and glacial landforms, landslides and soil erosion landforms, and riverline and delta landforms is discussed. V.P.

A71-26531 # The Bonanza project - Remote sensing for mineral and water resources. R. G. Reeves, L. H. Jefferis, D. H. Knepper, Jr., R. W. Marrs, and G. L. Raines (Colorado School of Mines, Golden, Colo.). In: Engineering for the space environment; American Society of Civil Engineers and American Institute of Aeronautics and Astronautics, Specialty Conference, Houston, Tex., April 15-17, 1970, Proceedings. New York, American Society of Civil Engineers, 1970, p. 67-92. 6 refs.

The Bonanza area of approximately 10,000 square miles in south central Colorado was selected for intensive research in the use of remote sensors for geologic and mineral and water resources investigations. The Bonanza area contains a variety of geologic features and mineral resources. Several major rivers, with numerous perennial and intermittent tributary streams, flow through the area, and the area contains extensive ground water resources. The area has been studied by faculty and students from the geology and geophysics departments of the Colorado School of Mines and other colleges and universities, and by geologists and geophysicists of the U.S. Geological Survey and other organizations. The geologic and hydrologic features of parts of the area are known in great detail, while other parts have been mapped in reconnaissance manner or not at all. Airborne remote sensors have been flown over the area at high

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and intermediate altitudes. These sensors have produced a large amount of data, mainly photographs and radar images which have been correlated with geologic and hydrologic features, soils, and vegetation. The objectives of the Bonanza project are to further perfect existing techniques and develop new ones for the interpretation of remote sensor data; to specify optimum sensors, sensor systems, and wavelengths for geologic and hydrologic studies; to promulgate space flight experiments; and to establish a remote sensor test site that can be used for calibration of space borne remote sensors and comparison of their data against known geologic, hydrologic, vegetation, soils, and other features and conditions.

(Author)

A71-28248 # Use of the results of magnetic surveys for determining secular variation. A. N. Pushkov (Akademiia Nauk SSSR, Institut Zemnogo Magnetizma, Ionosfery i Rasprostraneniia Radiovoln, Krasnaya Pakhra, USSR). (*Geomagnetizm i Aeronomiia*, vol. 10, no. 5, 1970, p. 873-877.) *Geomagnetism and Aeronomy*, vol. 10, no. 5, 1970, p. 689-692. 6 refs. Translation.

Development of a method of determining the secular variation of the magnetic field from magnetic surveys performed during different years, with particular reference to measurements performed with a proton magnetometer (accuracy within roughly 20 gamma). It is found that a contoured magnetic anomaly chart obtained by this method within the Gulf of Aden has a negative value (roughly -20 gamma/year) for the secular variation, as confirmed by the results obtained by Whitmarsh and Jones (1969) by another method. The method proposed has the advantage of being applicable for any region on which magnetic data exist.

V.P.

A71-31898 A proposed meteorite crater in southeastern Mongolia. O. D. Suetenko and L. M. Shkerin (Akademiia Nauk SSSR, Geologicheskii Institut, Moscow, USSR). (*Astronomicheskii Vestnik*, vol. 4, Oct.-Dec. 1970, p. 261-263.) *Solar System Research*, vol. 4, Oct.-Dec. 1970, p. 214, 215. Translation.

Description of a craterlike feature 1.3 km in diameter located roughly 90 km SE from the town of Sain-Shand in southeastern Mongolia. Observations carried out in the summer of 1968 on the spot and aerial photography suggest that the crater may be a formation unrelated to the geological structure of the site and that it disrupts the natural paleozoic rock layers of the area. It is thought that this eroded crater may have been produced by the impact of a meteorite. Further studies are suggested to determine the origin of the crater with more certainty.

V.Z.

A71-33150 # Some geophysical implications of the satellite-determined geogravity field. Mohammad Asadullah Khan (Hawaii, University, Honolulu, Hawaii). *Geophysical Journal*, vol. 23, June 1971, p. 15-43. 67 refs.

Possible locations for the sources of the low-degree gravity harmonics are examined in the context of the interrelationships of the geogravity field with the geomagnetic field and its drifting and nondrifting parts as well as certain other geophysical controls. The available evidence does not support the westward drift of the gravity field. The hypothesis that the upper mantle is the most probable location for a bulk of the mass anomalies which produce the low-degree gravity harmonics seems to be most acceptable at this stage of our knowledge. A bulk of the mass anomalies is believed to be generated by lateral compositional and thermal variations in the asthenosphere. These variations also seem to be responsible for a major part of the observed correlation between the geogravity field and the geomagnetic secular variations by dint of their property of affecting both the density and electrical conductivity of materials. Lateral heterogeneities of the asthenosphere seem to be closely associated with relative motions in the asthenosphere and seem to play an important role in the tectonic model which explains continental drift as a result of sea-floor spreading.

(Author)

A71-35890 * Remote-sensing investigations near Mill Creek, Oklahoma. L. C. Rowan (U.S. Geological Survey, Denver, Colo.) and P. J. Cannon (U.S. Geological Survey, Flagstaff, Ariz.). *Oklahoma Geology Notes*, vol. 30, Dec. 1970, p. 127-135. 11 refs. NASA-supported research.

These investigations by the U.S. Geological Survey have demonstrated the usefulness in the test site of side-looking radar images for delineating fractures and faults, and of IR images for discriminating limestone, dolomite, and granite. The thermal contrast of the limestone and dolomite in the predawn image can be explained in terms of the thermal and reflectivity properties of the two rock types.

M.M.

A71-36366 * Imaging radars for geoscience use. R. K. Moore (University of Kansas Center for Research, Inc., Lawrence, Kan.) and G. C. Thomann (NASA, Mississippi Test Facility, Bay St. Louis, Miss.). *IEEE Transactions on Geoscience Electronics*, vol. GE-9, July 1971, p. 155-164. 23 refs.

Properties of a side-looking airborne radar (SLAR) designed for geoscience rather than military use are presented. The speckled nature of usual single-frequency radar images may be reduced by averaging in azimuth and by averaging in range or transmitting excess range bandwidth. With synthetic aperture systems, averaging is possible in both range and azimuth, but only range averaging (excess bandwidth) is reasonable with most real-aperture systems. Multi-spectral sensing appears to offer advantages for radar comparable with those for photography, on the basis of experimental spectral response curves. Matching the transfer characteristics of receiver, recorder, and film is necessary to achieve quality images. Special techniques may be necessary to permit discriminating targets of similar radar return while at the same time allowing for the very wide total range of returns. The calibration necessary to achieve repeatable results and permit use of automatic data processing may be obtained by inserting a stepped sample of transmitter signal into the receiver to place calibration blocks on the image. Both multiple look-angle coverage with a single flight line and stereo can be achieved by use of fore-and-aft squinted antennas for alternate transmissions.

(Author)

A71-41862 * # Geologic uses of earth-orbital photography. Paul D. Lowman, Jr. (NASA, Goddard Space Flight Center, Planetary Branch, Greenbelt, Md.). *International Astronautical Federation, International Astronautical Congress, 22nd, Brussels, Belgium, Sept. 20-25, 1971, Paper. 38 p.* 10 refs.

This paper reviews the geologic applications of orbital photography, with four case histories of such applications to demonstrate its unique advantages. These case histories include discovery of unmapped faults in southern California, discovery of an unmapped volcanic field in northern Mexico, the finding of evidence that so-called Texas lineament is a broad zone of folding and dip-slip faulting, and the demonstration of the great importance of wind erosion as a land-sculpturing agent in North Africa. These examples show the advantages of orbital photography over aerial photography to be: (1) large area per picture, (2) adaptability to direct study of large areas by individual geologists, (3) coverage of areas inaccessible to aerial photography, (4) global coverage, and (5) availability and economy of color and multispectral coverage. Orbital photographs can be used to check the accuracy of existing geologic maps, to compare the geology and geomorphology of widely separated areas, and to study specific geologic problems involving large areas. It is stressed that orbital photography is not simply high-altitude aerial photography, but essentially a new tool with new uses.

(Author)

A71-42004 # Determination and registration of geothermic processes in the range of volcanic activity by satellite air pictures (Bestimmung und Erfassung geothermischer Prozesse im Bereich vulkanischer Aktivität mittels Satellitenluftbildern). Heinz Kaminski (Bochum, Sternwarte, Bochum, West Germany). *International Astronautical Federation, International Astronautical Congress, 22nd, Brussels, Belgium, Sept. 20-25, 1971, Paper. 46 p.* In German.

Data are presented which show that long-term satellite infrared measurements at wavelengths between 3.4 and 4.1 microns provide an effective means of checking the activity of volcanic centers on the earth. By continuously correlating the activity parameters measured at the volcanic centers and from satellites, it should be possible to predict the activity behavior of individual volcanic zones. V.P.

A72-11780 # The utilization of near-space television images of the earth in the study of regional geological structure. I. I. Bashilova, V. K. Eremin, and G. V. Makhin (Ministry of Geology, Leningrad, USSR). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 125-131.

Consideration of the advantages of television imagery over photographs, among which are the facts that it can be received systematically and repeatedly for all portions of the earth not covered by clouds, and that television imagery obtained from unpiloted satellites is obtained at a much lower cost than the photographs obtained from piloted spacecraft. The methodology for interpreting television images for geological purposes has two important requirements: the image should be viewed in stereo with identification made on stereo pairs selected from successive orbits; and the interpretation of individual images should be combined with the study of an overall schematic photo map. The interpretation of television images depicting one of the most complex regions of Asia (India) is described in detail. F.R.L.

A72-11786 # Surface heat flow studies for remote sensing of geothermal resources. H. Hase (Geological Survey of Japan, Kawasaki, Japan). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 237-245. 9 refs.

A study of surface geothermal heat flow for a future quantitative geothermal heat flow survey by thermal IR remote sensing was done. A nighttime heat budget equation at a geothermal surface is given, and geothermal heat flow intensity is categorized into three grades based upon the intensity of solar energy and geothermal heat energy. Diurnal temperature measurements across the earth-air interface were done at geothermal surfaces, and one example of the limitation of detectable geothermal heat flow intensity was obtained. (Author)

A72-11787 * # Discrimination of basic silicate rocks by recognition maps processed from aerial infrared data. R. K. Vincent and F. J. Thomson (Michigan, University, Ann Arbor, Mich.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 247-252. Contract No. NAS9-9784.

A method is presented which can be used to map silicate rock-type from aerial infrared data. The method has been partially tested over a sand quarry at Mill Creek, Oklahoma, in which highly siliceous targets were discriminated from nonsilicates in the scene. The technique is currently being tested experimentally on basic silicates. On the basis of the Mill Creek results and theoretical considerations, percent SiO₂ differences as small as 14% should be detectable with the University of Michigan's currently available detectors. (Author)

A72-11788 * # Remote sensing of some sedimentary rocks. P. A. Brennan (Aero Service Corp., Philadelphia, Pa.) and J. Lintz, Jr. (Nevada, University, Reno, Nev.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 253-268. Research supported by the University of Nevada and the World Resources Corp.; Grant No. NGR-29-001-015.

Sedimentary rocks including varying sized clastics and carbonates were overflown by aircraft between 1966 and 1971 producing data in the ultraviolet to microwave regions of the electromagnetic spectrum. This paper reports that multispectral analysis increases the ease and rapidity of discrimination of rock types having subtle differences in physical characteristics, but fails to enhance and may degrade distinctions where physical characteristics are significantly different. Brief resumes of color and color IR photographic data are presented. Thermal infrared is found to be useful in the mapping of rock units, but limitations such as moisture variation, soil cover, and vegetation may exceed in one formation the distinction between differing lithologies. A brief review of previously published SLAR data is included for completeness. Remote sensing techniques should reduce field geological effort by as much as 50%. (Author)

A72-11791 # A spatial frequency analysis of the geologic information content of slar images. T. A. Eppes and J. W. Rouse, Jr. (Texas A & M University, College Station, Tex.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 299-315. 5 refs.

The effect of sensor viewing angle on the detectability of linears in the radar image data has been investigated experimentally using spatial frequency analysis techniques. Results show that simulations of radar imagery provide an accurate approximation to actual radar imagery as far as radar shadowing is concerned. Subsequently, an interpretation of look-direction effects in terms of the frequency components or power spectra of the image is possible. O.H.

A72-11795 # Thermal-infrared-scanner for hydrogeological and geological survey in the Northern Alps. J. Bodechtel (München, Universität, Munich, West Germany). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 365-371. 6 refs. Research supported by the Deutsche Forschungsgemeinschaft.

A thermal infrared scanner (8-14 microns) was used for systematic investigations of the hydrology, lithology and tectonic in the subalpine region of southern Bavaria over the period of one year. Different flight directions, flights at different times of day and night, in various altitudes, were compared. (Author)

A72-11826 # Remote sensing by photogeology applied to ground current paths in an HVDC system. I. C. Bechtold and R. H. Jahns (Stanford University, Stanford, Calif.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 2. Ann Arbor, University of Michigan, 1971, p. 951-971. 54 refs.

Electrical ground current concentration paths were mapped in southern California and southern Nevada in study of anticipated effects from HVDC transmission systems. Many of these paths were found to follow buried saline deposits. Subsequent X-15 space photography showed similar paths clearly in near infrared sensitive films. The fine-grained carbonate, sulphate and silicate minerals concentrated on the surface of the Pleistocene drainage systems are believed to be the source of high reflectance in the near infrared. (Author)

A72-11877 # Application of thermal modeling in the geologic interpretation of IR images. K. Watson, L. C. Rowan, and T. W. Offield (U.S. Geological Survey, Denver, Colo.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 2017-2041. 13 refs.

Description of the development of a mathematical model, based on physical principles, which provides a frame of reference by which the thermal behavior of geologic materials can be understood and predicted for a variety of circumstances. The model was applied initially in the geologic interpretation of reconnaissance data collected by an airborne thermal-IR scanner in December 1968, and refined on the basis of new parameters observed on a June 1970 flight. This parallel development of model and geologic application has led to a more complete understanding of a variety of physical and geologic parameters and their roles in governing the diurnal temperature behavior of geologic materials in their natural settings. M.M.

A72-11878 * # Automated geologic mapping using rock reflectances. R. D. Watson and L. C. Rowan (U.S. Geological Survey, Denver, Colo.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 2043-2053. 14 refs. Contract No. 160-75-01-43-10.

Investigation of the feasibility of preparing geologic maps automatically through computer processing of calibrated narrow-band visible and near IR reflectivity data collected with a 12-channel scanner. Five procedures were followed in the computer analysis of the radiances recorded as voltages on analog magnetic tape. Three recognition maps have been generated iteratively using a progressively more complex classification scheme. The overall accuracy of the first recognition map was 80%, but the discrimination of the limestone and dolomite was only 50-60%. All three maps are very accurate outcrop maps. The results demonstrate the feasibility of automated geologic mapping in this relatively simple setting. M.M.

A72-11891 # Evaluation of hyperaltitude photography for geological mapping. H. E. C. van der Meer Mohr and K. Krishnanunni (International Institute for Aerial Survey and Earth Sciences, Delft, Netherlands). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 2307-2318.

A comparative study was carried out in order to evaluate the utility of hyperaltitude photography for geological mapping. For this purpose a Gemini IV photograph, taken over part of the Arabian Peninsula, was analyzed and the results were compared with the information obtainable from conventional aerial photography. Analysis was done with standard (nonautomatic) interpretation methods. The two data sets were furthermore compared with two existing geological maps showing the latest published information of that area. The four data sets were then evaluated in terms of numbers of geological categories contained in each of them. (Author)

A72-18228 # Application possibilities of remote sensing methods in geology (Anwendungsmöglichkeiten von Fernerkundungsverfahren in der Geologie). P. Kronberg (Clausthal, Technische Universität, Clausthal, West Germany). Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Fernerkundung der Erdoberfläche, Munich, West Germany, Dec. 9, 1971, Paper. 11 p. In German.

Remote sensing methods applicable to local and regional geological surveys are reviewed. Black and white, color, and multispectral photographic and television techniques are discussed, along with infrared and multispectral scanning methods and single- or multiple-frequency radar procedures using polarization. Examples of aerial and satellite photography and photographic data processing are used to illustrate some of the potentialities of remote sensing. Some of the newer possibilities that these techniques and methods hold forth for the study of geological processes are pointed out. M.V.E.

A72-22017 * Infrared spectral emittance in geological mapping - Airborne spectrometer data from Pisgah Crater, California. R. J. P. Lyon (Stanford University, Stanford, Calif.). *Science*, vol. 175, Mar. 3, 1972, p. 983-986. 11 refs. Contract No. NAS9-7313.

Measurements of spectral emittance in the IR region from 6.8 to 13.3 microns were made with an airborne spectrometer on flights at 650 m above the olivine basalt flows at Pisgah Crater in the southern Californian desert. Readings were taken at a rate of six spectra per second. The spectra show chemical and mineralogical differences that can be related to differences in the terrain below the aircraft. T.M.

A72-23294 # The use of colour aerial photography in photogeological interpretation of Precambrian terrain in West Greenland. G. Henderson (Gronlands Geologiska Undersogelse, Copenhagen, Denmark). In: Internationale Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 1. Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 433-445.

Comparison of black-and-white and color photography to evaluate their relative usefulness in photogeological interpretation of particular areas. Because of the subtle tonal variations obtained with color photography it is easier to distinguish the various rock types. Many major folds and faults are clear on both types of photographs, but it is easier to see structural details on color photographs. The advantages of color photography become even more apparent when pairs of photos are viewed under the stereoscope. F.R.L.

A72-25109 Nimbus IV view of the major structural features of Alaska. E. H. Lathram (U.S. Geological Survey, Menlo Park, Calif.). *Science*, vol. 175, Mar. 31, 1972, p. 1423-1427.

Description of regional geologic features shown by pictures of Alaska and Western Canada which were taken by an Image Dissection Camera System (IDCS) carried by the Nimbus 4 satellite. The IDCS consists of a shutterless electronic scan and step tube mounted behind a wide-angle lens which performs continuous scanning at right angles to the line of flight, and 800-step-per-image stepping parallel to it. Length-to-width ratios of ground feature images nearly equal to those of ground features themselves were obtained by properly matching the scanning and stepping processes and the orbital motion of the satellite. Some representative pictures and a geological map of Alaska are given, showing that many of the major structural feature can be identified by Nimbus 4 IDCS pictures taken from 1100-km altitudes with a relatively low ground resolution. V.Z.

A72-30321 * Spectral compositional imaging of silicate rocks. R. K. Vincent and F. Thomson (Michigan, University, Ann Arbor, Mich.). *Journal of Geophysical Research*, vol. 77, May 10, 1972, p. 2465-2472. 9 refs. Contract No. NAS9-9784.

A technique is presented for the broad-scale mapping of gross compositional differences in silicate rocks from three medium-width (2 to 3 microns) spectral channels of thermal infrared scanner data. Ratios of radiances in two of the channels as measured by a two-element Hg:Cd:Te detector from an altitude of 1000 meters are calculated for 25 silicate rocks. The ratios are shown to be nearly linearly correlated with the position of the centers of gravity of the reststrahlen spectral emissivity features, as measured in the laboratory. Further, the ratios are shown to be generally correlated with SiO₂ content of silicate rocks. A third channel is proposed for correction of temperature variations across the scene. (Author)

A72-32888 Geophysical interpretation of density anomalies of the earth computed from satellite observations and gravity measurements. K. R. Koch (Bonn, Universität, Bonn, West Germany). *Zeitschrift für Geophysik*, vol. 38, May 1972, p. 75-84. 14 refs.

Density values for the potential of a simple layer distributed over the surface of the earth are computed from a combination of

Doppler observations to earth satellites and of gravity anomalies. The density values referred to an ellipsoid in hydrostatic equilibrium are used for geophysical interpretations. By taking additional results from seismic measurements it can be concluded that the density anomalies which cause the geopotential lie in the crust and upper mantle. Positive density anomalies are found at the zones of compression in the system of global tectonics i.e. at the trenches and island arcs. Positive anomalies prevail also in the zones of ocean rises. (Author)

A73-39477 * Microwave emission from geological materials - Observations of interference effects. J. C. Blinn, III, J. E. Conel (California Institute of Technology, Jet Propulsion Laboratory, Space Sciences Div., Pasadena, Calif.), and J. G. Quade (Nevada, University, Reno, Nev.). *Journal of Geophysical Research*, vol. 77, Aug. 10, 1972, p. 4366-4378. 12 refs. Contract No. NAS9-7779.

Microwave radiometric field observations were conducted at wavelengths of 21, 2.8, and 0.95 cm to determine the microwave penetration depth of a number of sands and gravels as a function of particle size and moisture content. Observations of a reflecting plate covered with varying thicknesses of test material exhibit a pronounced oscillatory behavior that is consistent with established electromagnetic theory for plane-parallel layered mediums. Utilization of this interference effect is proposed as a microwave radiometric technique for determining the bulk electrical properties of geologic materials, snow, ice, and other materials readily adapted to layering experiments. (Author)

A73-42526 * The prospects for mineral analysis by remote infrared spectroscopy. J. R. Aronson and A. G. Emslie (Arthur D. Little, Inc., Cambridge, Mass.). (*Conference on Lunar Geophysics, Houston, Tex., Oct. 18-21, 1971.*) *The Moon*, vol. 5, Sept. 1972, p. 3-15. Contracts No. NAS9-10875; No. F19628-67-C-0353.

An investigation of the effects of physical parameters on the spectra of minerals has been carried out, and an attempt made to develop a comprehensive theory of the reflectance (or emittance) spectra of particulate surfaces. The theory involves the effects of particle size, surface roughness, porosity, and mixing ratios on the spectra of mineralogical assemblages. The true spectral information is represented by the refractive indices and absorption coefficients of the constituent minerals. The present theory and the Mie theory for a cloud of well separated quartz particles are compared, as well as theoretical and experimental reflectances of quartz powders, glass beads, and corundum powders. Experimental results of abrading sapphire are presented. F.R.L.

A73-17189 Magnetotelluric and geomagnetic depth sounding methods compared. F. E. M. Lilley and H. Y. Tammemagi (Australian National University, Canberra, Australia). *Nature Physical Science*, vol. 240, Dec. 25, 1972, p. 184-187. 8 refs.

Observations of five terrestrial electric and magnetic parameters are reported, giving attention to northward, eastward, and vertically down magnetic field components, and the northward and eastward surface electric field components. The observations were made in southern Australia with the aid of telluric recording equipment and a magnetic variometer array. The studies conducted demonstrate the complementary nature of the magnetotelluric and geomagnetic depth sounding method. G.R.

A73-18282 Remote sensing practicality - Radar geology. H. C. MacDonald and W. P. Waite (Arkansas, University, Fayetteville, Ark.). In: Annual Electro-Optical Systems Design Conference, 4th, New York, N.Y., September 12-14, 1972, Proceedings of the Technical Program. Chicago, Industrial and Scientific Conference Management, Inc., 1972, p. 68-78. 20 refs.

The sidelooking airborne radar system is the typical configuration used for radar environmental remote sensing. During the operation of this system, an image of the terrain is recorded on the film as a continuous strip map. The fundamental parameters that

affect radar terrain return include terrain roughness, incidence angle, complex dielectric constant, frequency, and polarization. Applications of the airborne radar include coastal mapping and landform analysis, engineering geology, and geological reconnaissance. G.R.

A73-27962 # 'Toros' side-looking radar system and its application for sea-ice condition study and for geologic explorations. V. M. Glushkov, V. B. Komarov, V. S. Loshtshilov, B. P. Niiavro, and V. A. Starostin. *International Society of Photogrammetry, International Congress for Photogrammetry, 12th, Ottawa, Canada, July 24-Aug. 4, 1972, Paper. 7 p.*

Side-looking radar systems make it possible to obtain terrain images at any time of the day and in any conditions, up to heavy cloudiness, the images being by their nature close to photographic ones. Surveying with the Toros system is performed by two narrow beams formed by parabolic antennas arranged along the aircraft fuselage, and directed normal to their axes. The Toros system makes it possible to compile maps of general ice distribution based on the results of ice surveys. Examples are given which demonstrate broad possibilities of using radar images for photogeological interpretation and for compiling structural tectonic and geomorphologic maps, as well as for interpretation of the (material) composition of rocks. F.R.L.

A73-39868 # Utilization of thermal infra-red ground measurements for determination of adequate surveying periods in remote sensing. F. Bonn, P. Clément, J. F. Gadbois, C. Jalbert, M. Lajeunesse, and C. Trudel (Sherbrooke, Université, Sherbrooke, Quebec, Canada). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 709-714. 11 refs.

A73-39893 * # Remote sensing aids geologic mapping. D. H. Knepper, Jr. and R. W. Marrs (Colorado School of Mines, Golden, Colo.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 1127-1136. 10 refs. Grant No. NGL-06-001-015.

Remote sensing techniques have been applied to general geologic mapping along the Rio Grande rift zone in central Colorado. A geologic map of about 1,100 square miles was prepared utilizing (1) prior published and unpublished maps, (2) detailed and reconnaissance field maps made for this study, and (3) remote sensor data interpretations. The map is to be used for interpretation of the complex Cenozoic tectonic and geomorphic histories of the area. Regional and local geologic mapping can be aided by the proper application of remote sensing techniques. Conventional color and color infrared photos contain a large amount of easily-extractable general geologic information and are easily used by geologists untrained in the field of remote sensing. Other kinds of sensor data used in this study, with the exception of SLAR imagery, were generally found to be impractical or inappropriate for broad-scale general geologic mapping. (Author)

A73-39894 * # Geological evaluation of remote sensing imagery of the Mesabi Range, Minnesota. A. S. Walker (Minnesota, University, Minneapolis, Minn.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 1137-1146. Research sponsored by the U.S. Geological Survey, Minnesota Geological Survey, and NASA.

Remote sensing imagery of Precambrian sedimentary, metasedimentary, and intrusive rocks of the Mesabi Range, Minnesota area was analyzed to determine how much geologic information was inherent in each type of imagery. High altitude panchromatic

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photography, radar, ultraviolet, and day and night thermal infrared imagery were examined. Geologic sketch maps were produced for each type of imagery. Radar appears to be the best imagery for mapping rock units and for locating regional faults. Few rock units could be found on the infrared imagery or on the panchromatic photography. Several previously unmapped faults were located, and the surface traces of some faults were extended. (Author)

A73-39895 # Thermal activity of the Uson Caldera based on infrared and photographic aerial survey. B. V. Shilin, N. A. Gusev, E. I. Vavilov, and E. Ia. Karizhenskii (Ministry of Geology, Laboratory for Aeromethods, Leningrad, USSR). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 1147-1157, 7 refs.

Currently, the study of thermally active geological regions has important significance not only from the aspect of studying the mechanisms of geothermal distribution processes, but also from the viewpoint of locating areas containing an important energy source - hot water. A method which enables one to quickly map large areas for the purpose of finding anomalous temperature regions is the recently developed infrared or thermal mapper. These mappers are sensitive to the thermal radiation emitted by the terrain in the 1.8 to 5.3 micron spectral intervals. Modern airborne IR equipment can detect temperature differences of the terrain with a high degree of sensitivity (tenths of a degree Celsius) which enables one to obtain an image of the terrain that approaches the quality obtainable by photographic means. The use of airborne IR mappers in surveying the thermally active volcanic regions of the Kamchatka peninsula is discussed and results of the survey are presented. (Author)

A73-39896 # Geological analysis of aerial thermography of the Canary Islands, Spain. R. S. Williams, Jr. (U.S. Geological Survey, Washington, D.C.) and D. Fernandopullé (UNESCO, Las Palmas, Canary Islands, Spain). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 1159-1194, 18 refs.

In May 1971, the seven main islands of the Canary Islands volcanic archipelago were surveyed with an airborne thermal infrared scanning radiometer. The survey objective was to locate, by thermal differences, any zones of ground water discharge (submarine springs) into the ocean. In addition, the geothermal area on Lanzarote, Montañas del Fuego de Timanfaya, and interior areas of other islands were surveyed. The seven principal islands and numerous islets of the Canary Islands group are volcanic in origin and trend in a northeast-southwest direction about 100 kilometers offshore from the Spanish Sahara. The islands are composed of several thick volcanic formations varying from basalts, trachytes, phonolites, ignimbrites to conglomeratic beds. (Author)

A73-39898 # The use of satellite photography in interpretation of regional geology. B. N. Raina (Indian Photo-Interpretation Institute, Dehra Dun, India). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 1213-1238, 28 refs.

Qualitative geological interpretation of two single Gemini photographs of Chang Chenmo and India-Nepal regions has been carried out. In spite of the small scale of the photographs, it has been possible to differentiate color shades, geomorphological expressions, and drainage patterns and to correlate them with the regional geological setup of the area. Major structural features have also been delineated, while some additional structural features, not previously known or suspected, have also been picked up on these photographs. This study has demonstrated that with sufficient background knowledge, enough information is available on these small-scale

photographs which a trained photogeologist can interpret for geological correlation and structural analysis on a regional basis. These small-scale photographs are of special interest in vast areas, where preparation of synthesized regional geological maps by conventional methods, or by interpretation of aerial photographs on larger scales is beset with many difficulties. (Author)

A73-39899 * # An ERTS multispectral scanner experiment for mapping iron compounds. R. K. Vincent (Michigan, Environmental Research Institute, Ann Arbor, Mich.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2.

Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 1239-1247, 8 refs. U.S. Department of the Interior Contract No. H0220064; Contracts No. NAS5-21783; No. NAS9-9784.

An experiment is described which is designed to produce visible-reflective infrared ratio images from ERTS satellite data. The ERTS-A multispectral scanner has two channels in the visible-reflective infrared wavelength region which should be capable of duplicating aircraft scanner results. The average reflectances in the four ERTS-A MSS spectral bands for a few minerals and some vegetation are tabulated. The mineral laboratory samples were granular, with a particle diameter range of 250 to 1200 micrometer. If there were no spectral atmospheric or illumination variation effects, the ratio of energies in band 1 to band 4 would permit discrimination of pyroxenes (found in basic and ultrabasic rocks), quartz (found in acidic rocks), limonite and hematite (iron oxides), and green vegetation, on the basis of their respective ratio magnitudes. F.R.L.

A73-40810 # The definition of the geotectonic domains of the Southern African crystalline shield by ERTS 1 imagery and its economic importance. M. J. Viljoen and R. P. Viljoen (Johannesburg Consolidated Investment Co., Ltd., Randfontein, Republic of South Africa). *COSPAR, Plenary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper. 17 p.*

The two main geological domains recognized are the ancient, so-called granite-greenstone cratonic nuclei and the younger encircling metamorphic mobile belts. The significance of ERTS-1 imagery as an aid in the identification of the distinctive patterns of the crystalline shield is discussed. It is concluded that the broad synoptic view provided by the imagery is ideally suited to a study of the diagnostic macrostructures of the two geotectonic domains considered. The information obtained regarding the contact zones of the two geologic environments may be of considerable economic importance, since basic/ultrabasic rocks containing some of the world's largest nickel deposits have been found along similar contact regions within the Canadian Shield. G.R.

A73-41078 Two probable astroblemes in Brazil. R. S. Dietz (NOAA, Atlantic Oceanographic and Meteorological Laboratories, Miami, Fla.) and B. M. French. *Nature*, vol. 244, Aug. 31, 1973, p. 561, 562, 11 refs.

The astroblemes considered include the Araguinha Dome and the Serra da Canghala structure. These two Brazilian structures are the first ancient astroblemes to be reported from South America. The impact origin of the Araguinha Dome has been established by the discovery of diagnostic shock-metamorphic effects in its rocks. No shock effects have yet been identified in rocks from the Serra da Canghala structure. G.R.

A73-41332 # A study of lineaments from a Zond 5 photograph of northern Africa. A. A. Grigor'ev (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR). In: Space research XIII; Proceedings of the Fifteenth Plenary Meeting, Madrid, Spain, May 10-24, 1972. Volume 1. Berlin, East Germany, Akademie-Verlag GmbH, 1973, p. 101-103.

By interpreting the global photograph from the automated interplanetary station Zond 5, detection was made of an entire network of lineaments on a planetary scale crossing the northern part of the African continent and having an extent of 150 to several hundred kilometers (about 30 of them were revealed most reliably). These lineaments, evidently, constitute large broken tectonic destructions most of which were unknown earlier. (Author)

N70-17597# New South Wales Univ., Kensington (Australia). School of Mining Engineering.

APPLICATION OF AERIAL GAMMA RADIATION SPECTROMETRY IN AUSTRALIAN MINERAL EXPLORATION

M. J. Lawrence 19 Mar. 1969 33 p refs Presented at the Australian Inst. of Mining and Metallurgy, Sydney, 1969 /Its Geol. Paper No. 3

(CONF-690815-1) Avail: CFSTI

The practice and experience of Geophysical Resources Development Co. with the technique of airborne gamma spectrometry are outlined and its particular application to uranium search is discussed. The basic theoretical principles of natural radioactivity are reviewed. A brief history of radiation detection instrumentation is presented, together with the theory underlying its design and operation. The primary consideration in the selection of survey system parameters is the variation of gamma flux with height. Other factors are terrain clearance, aircraft speed, instrument time constant, and line spacing. Survey aircraft requirements are exceptional performance and dependability, high maneuverability, low stall and high cruise speeds, sufficient power for instrument supply, room for electronic installation, low initial and operating costs, and adaptability. NSA

N70-22341# Sandia Corp., Albuquerque, N.Mex.

THE USE OF INSTRUMENTED PENETROMETERS TO DETERMINE SUBSOIL CONDITIONS AT INACCESSIBLE SITES

John L. Colp Oct. 1969 43 p refs Sponsored by AEC (PB-188139; SC-DR-69-573) Avail: CFSTI CSCL 08M

A remote sensing study demonstrates that an air-dropped instrumented penetrometer can produce reliable information on subsoil conditions at a location inaccessible by direct means, and that sufficient experience now exists to analyze this information repeatedly. Author (USGRDR)

N70-23387# Leiden Univ. (Netherlands).

THE OSCILLATORY MOTION OF THE MAGNETOPAUSE AND THE EARTH'S BOW SHOCK

Gjalt Roelof Smit (Ph.D. Thesis) 1969 53 p refs Sponsored by ESRO

Avail: CFSTI

Satellite observations have shown that the magnetopause and the bow shock in front of it are in an oscillatory motion. The interaction between the solar wind and the geomagnetic field is summarized, and the observations concerning the motion of the two surfaces are discussed. They are separated into two classes: a fast motion with a period of 6 to 10 minutes and an amplitude of 0.1 to 2 R sub E, and a slow motion with a period of 20 to 100 minutes and an amplitude of 0.5 to 3 R sub E. A model is introduced that replaces the fast motion of the magnetopause by a resonance vibration driven by fluctuations in the solar wind. The fast motion of the bow shock is treated by observing the motion as a curved shock wave standing against an oscillating axisymmetric body (the magnetopause) that is placed in a time-dependent gas-dynamic flow. The slow motion of the two surfaces is explained as an adiabatic compression and expansion as a result of slow changes in the characteristics of the solar wind. ESRO

N70-23567# National Academy of Sciences-National Research Council, Washington, D.C. Div. of Engineering.

USEFUL APPLICATIONS OF EARTH-ORIENTED SATELLITES: POINTS-TO-POINT COMMUNICATION PANEL 7

1969 157 p refs

(Contract NSR-09-012-909)

(NASA-CR-109330) Avail: CFSTI CSCL 22B

A communication satellite able to interrogate and collect data from large numbers and types of widely distributed data collecting platforms, and subsequently to relay those data to specific centers for processing data (ground data handling (GDH) centers) is considered. When coupled with data processing centers geared to the requirements of particular services such points-to-point communication satellites promise sizable benefits to the nation and ultimately to all mankind. The task undertaken on points-to-point communications in this study of practical application of earth-oriented satellites begins with a survey of the global communications traffic presented by the complex of data collecting platforms and ends with findings and recommendations whose implementation could help make the dream a reality. Author

N70-26129# Massachusetts Inst. of Tech., Cambridge.

SHORT-TERM DYNAMICS OF THE SOLID EARTH

In its The Terrestrial Environ. Apr. 1970 26 p refs (See N70-26126 12-13)

Avail: CFSTI CSCL 08F

A program is presented to advance the understanding of short-term earth dynamics. The first objective calls for refined inertial and terrestrial coordinate systems, and for precise relations between them. In addition, a planetary coordinate system should be defined. The determination of the rotational motions of the earth, and the generation of theoretical models and interpretations of these motions are discussed. Emphasis is placed on the need to monitor and interpret the earth tidal motions including the effects of ocean loading (surface displacements should be determined to a + or - 16 cm accuracy with respect to a terrestrial coordinate system). It is recommended that a program should be established based on an analysis of satellite dynamics to measure mass displacements in the earth that produce changes of one part in 10 to the 8th power in the position of a satellite. M.G.J.

N70-26130# Massachusetts Inst. of Tech., Cambridge.

LONG-TERM DYNAMICS OF THE SOLID EARTH

In its The Terrestrial Environ. Apr. 1970 35 p refs (See N70-26126 12-13)

Avail: CFSTI CSCL 08F

Topics that may be classed as relatively long-term effects include five broad areas: (1) earth movements of various types, (2) the earth's gravity field, (3) physical processes acting within the earth's mantle (particularly convection currents and other possible driving mechanisms for global tectonics), (4) geological data pertinent to the physics of the earth such as satellite photography, and (5) glaciology. Transmission of geophysical data by satellite is an additional area that appears to offer a large potential for the solution of geophysical problems. Earth movements as considered here include displacements along major faults both preceding and at the time of major earthquakes, motions of the earth's surface on an intercontinental scale, strains and stresses associated with major fault zones, and vertical motions such as those related to glacial rebound and earthquakes. Several important contributions to a fundamental understanding of the physics of the earth, to earthquake prediction, and to the rapid identification (and hence warning) of earthquakes that have generated seismic sea waves (tsunamis) appear to be possible in the next 10 years. A new class of problems can be attacked if a precision of 1 to 20 cm becomes available in the measurement of long distances. This precision is needed for studies of continental drift, earth strain, and earthquake prediction. Author

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N70-26852# Kansas Univ., Lawrence. Dept. of Geography.
**THE USE OF AIR PHOTOS IN A STUDY OF LANDSLIDES
IN NEW GUINEA**

David S. Simonett, Richard L. Schuman, and Donald L. Williams
Jan. 1970 63 p refs
(Contract Nonr-583(11))

(AD-701743; TR-5) Avail: CFSTI CSCL 8/13

Techniques are described which were developed for the determination of relations between air photo and field data on landslides in New Guinea. These techniques were designed so that air photos could be used to estimate frequency of landsliding, and the ages, volumes and types of landslides as well as their contribution to denudation through time. The development, application and accuracy of the techniques is discussed. Author (TAB)

N70-28539*# Ohio State Univ., Columbus. ElectroScience Lab.
**RADAR BACKSCATTERING DATA FOR SURFACES OF
GEOLOGICAL INTEREST**

C. H. Shultz, T. L. Oliver, and W. H. Peake 2 Dec. 1969 89 p
refs
(Contract NSR-36-008-027)

(NASA-CR-110131; TR-1903-7) Avail: CFSTI CSCL 08G

This report presents measurements of the normalized backscattering cross section (per unit projected area) which have been made over the past few years on a number of surfaces of geological interest. The significance of these ground-based radar measurements is two-fold: first, they serve as a calibration for airborne radars and provide estimates of radar return for system designers; secondly, they provide measurements over well-defined, homogeneous surfaces which are accompanied by rather detailed surface descriptions. Thus they can serve as basic data for the interpretation of surface response in terms of surface parameters. Author

N70-30679# Joint Publications Research Service, Washington,
D.C.

TERRESTRIAL GEOPHYSICS

In its Soviet-Bloc Res. in Geophys., Astronomy and Space, No.
228 13 May 1970 p 32-50

Avail: CFSTI

Descriptions are given of aerial surveys from aircraft and satellites, a radio controlled seismograph with magnetic recording, electrochemical seismic detectors, exchange waves to study seismicity beneath Alma-Ata, a quartz astatic element, isotope geochronology and deep crustal structure, geological interpretation of magnetic measurements in Antarctica, discriminating regional background in interpreting gravity and magnetic anomalies, determining absorption of explosive waves in the ground from records of stresses and strains, use of a radio range finder in marine geophysical work, geodetic programs for Minsk-2 electronic computer, discontinuities in upper crust, the mechanism of volcanic earthquakes, generation of microseisms in Sea of Akhotsk, horizontal inhomogeneities in earth interior, and earthquake prediction by hydrogeological methods. R.B.

N70-32363# Air Force Systems Command, Wright-Patterson
AFB, Ohio. Foreign Technology Div.

THERMAL AERIAL SURVEY OF KAMCHATKA VOLCANOES

B. V. Shilin et al 6 Mar. 1970 20 p refs Transl. into ENGLISH
from Sov. Geol. (Moscow), v. 12, no. 5, 1969 p 139-147
(AD-704830; FTD-HT-23-63-70) Avail: CFSTI CSCL 8/7

The article deals with infrared (IR) aerial surveying as a new, effective method of studying volcanic foci. Basic merit of IR aerial surveying lies in the possibility of obtaining a true instantaneous picture of the heat chart of a volcanic focus. Results from IR aerial surveys of several Kamchatka volcanoes are presented. Author (TAB)

N70-32931*# Stanford Univ., Calif. Remote Sensing Lab.
**PHENOMENA AND PROPERTIES OF GEOLOGIC
MATERIALS AFFECTING MICROWAVES: A REVIEW**

Deane Oberste-Lehn Apr. 1970 72 p refs
(Contract NAS9-7313)

(NASA-CR-108547; SU-TR-70-10) Avail: CFSTI CSCL 08G

A literature search made on microwave remote sensing included material on electromagnetic theory, parameters affecting passive microwave systems, and properties of natural occurring materials. Some results and conclusions reached were: (1) data on electric and thermal properties of materials are lacking in quality and quantity; (2) systematic analyses are needed of parameters in the microwave portion of the spectrum under conditions that would make the data useful for remote sensing purposes; (3) the complex compositional, structural, and temporally-dependent make-up of the natural environment suggests that even a fundamentally sound knowledge of elemental interactions with electromagnetic radiation is probably insufficient to completely solve real world problems; and (4) the empirical approach of making parametric measurements under carefully selected field conditions may provide better insight into the causes of the integrated responses recorded by passive microwave systems. Author

N70-33736*# Stanford Univ., Calif. Remote Sensing Lab.
**DETAILED GROUND STUDY OF 8-13 MICRON INFRARED
IMAGERY, CARRIZO PLAINS, CALIFORNIA**

Robert W. Campbell, Jr., Lawrence D. Hoover, and Francisco
Querol-Sune Jan. 1970 72 p refs

(Contract NAS9-7313)

(NASA-CR-108493; TR-70-1) Avail: CFSTI CSCL 08G

A field study of the Carrizo Plains area, central California, was undertaken over a 48-hour period from May 31 to June 1, 1969, to check in detail the causes of the dark (cold) thermal anomalies associated with the San Andreas fault trace as previously detected 4 years earlier on thermal infrared (the 8-13 micron band) imagery. Radiometric and contact ground temperatures showed a strong negative correlation with moisture content of the near-surface soil. The original anomaly on the imagery was also redetected and further defined by the ground temperature measurements. The NE side of the fault trace had a higher soil moisture content, and a correspondingly lower temperature than the SW side. Radiometric temperatures were consistently lower than contact ground temperatures. Several effects related to this variation are discussed. Humidity, topography, vegetation cover, and time of night influence the temperatures obtained. Author

N70-36327# Bureau of Mineral Resources, Geology and
Geophysics, Canberra (Australia). Geophysical Branch.

**STRANGWAYS RANGE DETAILED AEROMAGNETIC SUR-
VEY, NORTHERN TERRITORY 1965**

D. B. Tipper 1969 30 p refs

(Rept-136) Avail: CFSTI

A detailed aeromagnetic survey over five areas in the Strangways Range, to the north and north-northeast of Alice Springs, was made. A total of 115 square miles was surveyed with the primary purpose of outlining possible extensions to known copper and apatite deposits and discovering any anomalous areas nearby. A secondary aim of the survey was to assist geological mapping. Regional and local geology are described. The operational details of the survey and an outline of the interpretation methods employed are given. Of the sixteen known mineral occurrences, five were found to have strong magnetic expression, three others are probably correlated with two magnetic anomalies, and a further two occurrences are very close to a fault interpreted from the magnetic data. Many other anomalies were recorded in all areas, and the majority are due to bodies that either crop out or are within 50 feet of the surface. Many, if not most, of these bodies are believed to be steeply dipping lenses and prismatic bodies of amphibolite interjacent with less magnetic gneissic and schistose rock. Thirty-one

faults are interpreted, many of which coincide with photolinear features, and three fold structures are tentatively proposed.

Author

N70-36328# Bureau of Mineral Resources, Geology, and Geophysics, Canberra (Australia). Geophysical Branch.
DALY RIVER DETAILED AEROMAGNETIC SURVEY, NORTHERN TERRITORY 1966

E. P. Shelley 1969 51 p refs

(Rept-139) Avail: CFSTI

During September 1966, a detailed aeromagnetic survey over 55 square miles of the Daly River Mineral Field was made. The area is located on the north side of the Daly River about 90 miles south-southwest of Darwin. The aims of the survey were to determine the source and extent of the copper mineralization and generally to assist geological mapping in areas of alluvial cover. Many magnetic anomalies were quantitatively analyzed, and the depths, dimensions, attitudes, and compositions of the bodies causing them are discussed in relation to the geological structure of the area. No anomalies can be directly correlated with the main localities, but anomalies occur over Warrs Mine and the Knowles Farm area. A prominent magnetic lineation that occurs between the mining localities is thought to be due to a dolerite body, which may be the source of the mineralization. The magnetic contour pattern delineates a south-plunging anticlinal structure in the southwest of the area. The source of the lineations is thought to be a series of basic intrusives folded with the sediments. Author

N70-36351# Joint Publications Research Service, Washington, D.C.

SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 233

29 Jul. 1970 88 p Transl. into ENGLISH from Russian reports (JPRS-51049) Avail: CFSTI

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N70-36355# Joint Publications Research Service, Washington, D.C.

TERRESTRIAL GEOPHYSICS

In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 233 29 Jul. 1970 p 18-28

Avail: CFSTI

News briefs are reported on a conference on aerial surveying, a symposium on planetary geophysical research, a network of seismic stations in Tadzhikistan, a method for recording magnetic field variations, and a quartz astatic galvanometer. Summaries are given for using an analytical geomagnetic field in the study of magnetic anomalies, the statistical characteristics of anomalous gravity and magnetic fields, the diurnal variation in the polarization axis of Pcl pulsations, the Moho relief in the Black Sea basin, a proposal for a magnetotelluric network, the deep structure of the Crimea and the surrounding region, strata with reduced velocities in the Ukrainian Shield, new volcanic-sedimentary formations in the Kurile Islands, and correlation of crustal parameters in Turkmenistan. R.B.

N70-36496# Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.

ANALYSIS OF MULTISPECTRAL SCANNER DATA FOR LOCATION OF SAND AND GRAVEL DEPOSITS Final Report

David S. Hanson and David R. Morganstein Jan. 1970 95 p

(Contract DAAK02-69-C-0705)

(AD-705673; BSR-2829) Avail: CFSTI CSCL 13/3

Data were collected with an 8-channel multispectral line scanner covering the UV, visible, and near IR. A test site near Lake Charles, Louisiana, was chosen as representative of river delta terrain in which the target materials, sand and gravel suitable for engineering construction, could be easily located for ground truth. Digital samples of tape recorded video were computer analyzed by a factor analysis program. The results of the analysis identified three basic terrain types, one of which is associated with the target materials, and permits automatic classification at real data rates to map extended areas of similar terrain. Author (TAB)

N70-38847*# Geological Survey, Washington, D.C.

PRELIMINARY EVALUATION OF RADAR IMAGERY OF YELLOWSTONE PARK, WYOMING

R. L. Christiansen, K. L. Pierce, H. J. Prostka, and E. T. Ruppel Jul. 1966 24 p *Its* Tech. Letter NASA-30

(NASA Order R-09)

(NASA-CR-76711) Avail: CFSTI CSCL 08G

Preliminary studies of radar imagery in the Yellowstone Park area show that it has certain valuable use in regional geological reconnaissance. Foremost among these are its all-weather capability and wide areal coverage. Geologic features are best expressed by topographic irregularities and include lineaments (faults and fractures), contrasting stream drainage patterns and glacial deposits. Flow structures in rhyolite flows enable one to distinguish rhyolite flows from ash flows and basaltic lava flows, whereas distinctive stream dissection patterns enable differentiation between lava flows and ash flows. Imprecisions and variability of scale are considered to be major disadvantages. Furthermore, there is no apparent expression of grain size, color or composition of rock types. Author

N70-38883*# Geological Survey, Washington, D.C.

INFRARED INVESTIGATIONS Status Report, 1 Jul. - 30 Sep. 1966

Robert M. Moxham Nov. 1966 13 p refs

(NASA Order R-146)

(NASA-CR-79892) Avail: CFSTI CSCL 08E

Aerial photography and radiometric data obtained during infrared surveys are presented. Techniques for aircraft navigation at night are evaluated, and fumarolic activity is reported for various areas. A study of the infrared spectral emittance of rocks is mentioned, as well as design of an apparatus for investigating possible infrared luminescence of rock-forming minerals in the vicinity of their characteristic frequencies. S.P.

N70-38884*# Geological Survey, Washington, D.C.

REFLECTANCE OF ROCKS AND MINERALS TO VISIBLE AND ULTRAVIOLET RADIATION

H. V. Watts (IIT Res. Inst., Chicago, Ill.) Jul. 1966 69 p refs *Its* Tech. Letter NASA-32

(NASA Order R-146-09-020-006)

(NASA-CR-76300) Avail: CFSTI CSCL 08E

The reflectances of 38 different samples of rocks and minerals were measured throughout the spectral range of 7000 Å down to 23000 Å, for both a flat ground surface and a polished surface of each material, except for the pumice and mica samples whose surfaces were measured as received. The diffuse reflectance was detected both with and without the inclusion of the specularly reflected component. None of the reflectance curves showed any characteristic peaks or bands. The shapes of the curves are generally the same for both the ground and the polished surfaces, with the total reflectance from the ground surface greater than that from the polished surface. For most samples the reflectance increases as the wavelength increases. Of major interest is the fact that the relative reflectance from sample to sample does not remain the same throughout the spectral range. Thus the contrast in imaging

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an array of different rocks could vary appreciably between a visible sensitive imager and an ultraviolet sensitive imager. Author

N70-38886* Geological Survey, Washington, D.C.
INTERPRETATION OF ULTRAVIOLET IMAGERY OF THE METEOR CRATER, SALTON SEA AND ARIZONA SEDIMENTARY TEST SITES (MISSION 18, JANUARY 1966)
 William R. Hemphill Aug. 1966 61 p refs /Its Tech. Letter NASA-39 and NASA Suppl-39A
 (NASA Order R-146-09-020-006)
 (NASA-CR-77594) Avail: CFSTI CSCL 08E

A discussion is presented on the imagery obtained of the Meteor Crater, the sedimentary test site, and the Salton Sea. Image contrasts of some features appear to be enhanced in the ultraviolet as compared to the same features on conventional aerial photographs. It is believed that repeated flights over these and other test areas should improve the ability to predict ultraviolet reflectivity and image tonal density in terms of specific geologic and terrain features. The test program suggests modifications in airborne operation of the ultraviolet line scanner. It is recommended that trial flights be made with and without the AGC circuitry in operation. Details are given on each of the test flights, and additional recommendations for changes to the test program are made. Samples of conventional photographs of the test sites are provided. H.S.W.

N70-38890* Geological Survey, Washington, D.C.
GEOLOGICAL UTILIZATION OF GEMINI COLOR PHOTOGRAPH OF DUBA AREA, SAUDI ARABIA
 Robert F. Johnson and Jules A. MacKallor Aug. 1966 12 p /Its Tech. Letter NASA-43
 (NASA Order R-09-020-015)
 (NASA-CR-77593) Avail: CFSTI CSCL 08G

The discovery of a large wrench fault in Saudi Arabia from a Gemini 5 photograph is reported. The boundary between the Precambrian basement and the younger rocks was found to be plainly visible on the color photograph, taken at an altitude of more than 100 miles. The alignment of wadis indicates a northwest-trending structural component throughout the entire area. It is suggested that the picture illustrates the value for arid regions of photographs from space. N.E.N.

N70-38892* Geological Survey, Menlo Park, Calif.
GEOLOGIC APPRAISAL OF RADAR IMAGERY OF SOUTHWESTERN OREGON
 William P. Irwin Jun. 1966 13 p /Its Tech. Letter NASA-23
 (NASA Order R-09-020-015)
 (NASA-CR-76690) Avail: CFSTI CSCL 08G

Radar imagery obtained in a flight extending from near Grants Pass to the coast is evaluated. The linear scale of the radar imagery, measured parallel to the flight path, is 1 inch equals approximately 2.8 miles. The eastern part of the imagery is of the Klamath Mountains geologic province, and the western part is of the coast ranges. Author

N70-38893* Geological Survey, Menlo Park, Calif.
GEOLOGICAL EVALUATION OF RADAR IMAGERY: SAN ANDREAS FAULT ZONE FROM STEVENS CREEK, SANTA CLARA COUNTY TO MUSSEL ROCK, SAN MATEO COUNTY, CALIFORNIA
 Robert D. Brown, Jr. Aug. 1966 15 p /Its Tech. Letter NASA-45
 (NASA Order R-09-020-015)
 (NASA-CR-77610) Avail: CFSTI CSCL 08G

Side-looking radar photography for geologic interpretation is discussed. A general evaluation is presented, and both polarized and depolarized imagery are described. It is pointed out that radar photography is unimpaired by cloud cover, the screening effect of

vegetation is greatly reduced, and contrast is enhanced. Depolarized images were found to be particularly valuable. N.E.N.

N70-38894* Geological Survey, Menlo Park, Calif.
GEOLOGICAL EVALUATION OF K BAND RADAR IMAGERY, NORTH-CENTRAL NEVADA
 Ralph J. Roberts Aug. 1966 15 p refs /Its Tech. Letter NASA-49
 (NASA Order R-09-020-015)
 (NASA-CR-77609) Avail: CFSTI CSCL 08G

Radar photography with a scale of 1:200,000 was evaluated for geological interpretation. The features of the area in Nevada are outlined. Few cultural features were recognized. Variations among specific lithologic types were not well shown, but structural features were noted that were not recognized in conventional photography at a scale of 1:62,500. It is concluded that radar imagery at this scale offers little help in differentiating small geologic units, but major rock units can be distinguished. N.E.N.

N70-38896* Geological Survey, Menlo Park, Calif.
APPLICATION OF RADAR IMAGERY TO A GEOLOGIC PROBLEM AT GLACIER PEAK VOLCANO, WASHINGTON
 Rowland Tabor Washington May 1966 4 p /Its Tech. Letter NASA-26
 (NASA Order R-09-020-015)
 (NASA-CR-113312) Avail: CFSTI CSCL 08G

Conventional and radar aerial photographs are presented, and the contrast on the radar imagery between the highly reflective solid rock and the less reflective unconsolidated deposits is described. N.E.N.

N70-38897* Geological Survey, Menlo Park, Calif.
PRELIMINARY GEOLOGIC MAP OF THE MONO CRATERS QUADRANGLE, CALIFORNIA
 Ronald W. Kistler Washington 1 Sep. 1965 4 p /Its Tech. Letter NASA-9
 (NASA Order R-146)
 (NASA-CR-68346) Avail: CFSTI CSCL 08B

The geological map of the Mono Craters, Sierra Nevada, California, is prepared at a scale of 1:48,000. E.E.B.

N70-38898* Geological Survey, Washington, D.C.
PRELIMINARY RESULTS OF AERIAL INFRARED SURVEYS AT PISGAH CRATER, CALIFORNIA
 W. A. Fischer, J. D. Friedman, and T. M. Sousa 22 Apr. 1965 16 p /Its Tech. Letter NASA-5
 (NASA Order R-146)
 (NASA-CR-62908) Avail: CFSTI CSCL 08E

Results are reported of aerial surveys utilizing the NASA remote sensing aircraft to test equipment under field conditions and to provide infrared imagery of the test site at various times of the day and from various spatial positions. Field measurements of surface temperatures and micro-relief, and laboratory measurements of reflectance were contrasted with measurements of film density on infrared images acquired at various times of the day. Measurements of microrelief were also contrasted with film densities of various materials imaged at increasingly oblique angles. Results suggest that unconsolidated materials possess a lower thermal inertia than consolidated materials, that unconsolidated materials emit larger quantities of infrared energy than consolidated materials when both are subjected to similar quantities of solar radiation, that film densities differ with angle of view, and that these relative quantities and changes in relative quantities of radiation may be observed from airborne platforms. S.C.W.

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**N70-38928*# Geological Survey, Denver, Colo.
A DISTINCTION BETWEEN BEDROCK AND
UNCONSOLIDATED DEPOSITS ON 3.6 MU INFRARED
IMAGERY OF THE YELLOWSTONE RHYOLITE PLATEAU**

Robert L. Christiansen May 1968 8 p refs
(NASA Order R-09-020-015)

(NASA-CR-94415; NASA-104) Avail: CFSTI CSCL08G

Infrared imagery covering most of Yellowstone National Park was obtained in August 1966, using the Reconofax 4 system in an aircraft flying at about 20,000 feet. This imagery was examined in order to evaluate the geologic information it contains in relation to a study of the Yellowstone rhyolite plateau. As most of the findings contained no new information about the capabilities of the system, they are reviewed briefly. One particular aspect of the interpretation, a clear local distinction between bedrock and superficial deposits, was noted. Author

**N70-38933*# Geological Survey, Washington, D.C.
EVALUATION OF NIMBUS VIDICON PHOTOGRAPHY—
SOUTHWEST FRANCE AND NORTHEAST SPAIN**

Edward G. Hasser Oct. 1966 16 p /ts Tech. Letter NASA-53
(NASA Order R-09-020-011)

(NASA-CR-78781) Avail: CFSTI CSCL08G

Southwest France and much of the Pyrenees are in a humid region and most of northeast Spain is arid or semiarid. The vegetation is the principal image maker. Its images are modified, particularly in southwest France, by terrain and cultural influences, such as plains and mountains, and the suitability of the terrain for irrigated and nonirrigated agriculture. The vegetation tends to mask landform boundaries, geology, and stream lines. Tones are lighter in the arid and semiarid regions and, therefore, slopes and stream beds are more noticeable in northeast Spain. Author

**N70-38934*# Geological Survey, Washington, D.C.
GEOLOGICAL EVALUATION OF NIMBUS VIDICON
IMAGERY—NORTHWEST GREENLAND**

William E. Davies Oct. 1966 15 p refs /ts Tech. Letter No. NASA-56

(NASA Order R-09-020-011)

(NASA-CR-78776) Avail: CFSTI CSCL08G

Two photos of Nimbus vidicon imagery cover northwest Greenland. They are characterized by extreme contrast between ice and land. Apparently exposure was keyed to the ice and as a result no tonal quality gradation exists on the land; also long shadows cover the lowlands. Because of this, the imagery contains little of geologic value. The extreme contrast emphasizes some valleys reflecting structural control and it is possible to discern major structural features. Scale distortion is small but relief on snow and ice is greatly exaggerated. Author

**N70-38935*# Geological Survey, Washington, D.C.
GEOLOGICAL EVALUATION OF RADAR IMAGERY,
APPALACHIAN PIEDMONT, HARFORD AND YORK
COUNTIES, MARYLAND AND PENNSYLVANIA**

David L. Southwick Oct. 1966 15 p /ts Tech. Letter No. NASA-48

(NASA Order R-09-020-015)

(NASA-CR-78778) Avail: CFSTI CSCL08G

Radar imagery of Harford County, Maryland and adjacent parts of York County, Pennsylvania was flown on August 20, 1965. Horizontally polarized high-frequency side-looking radar was employed and two images were produced from horizontally and vertically polarized components of the return signal. Overlapping strips covering about 700 sq. mi of country were obtained. The scale varies but is approximately 1:200,000. The area surveyed contains a wide variety of metamorphic and igneous rocks that for the most part are deeply weathered and mantled by saprolite and soil. In general the topography is low and rolling with steep slopes

only near incised major streams. Much of the county is farmed and the remainder is covered with hardwood forest. The radar imagery reveals neither soil-lithologic variations nor linear features. Author

**N70-38936*# Geological Survey, Menlo Park, Calif.
PHOTOGEOLOGIC INTERPRETATION OF GEMINI 4
COLOR PHOTOGRAPHY: BAJA, CALIFORNIA**

Rowland Tabor Washington May 1966 7 p /ts Tech. Letter NASA-24

(NASA Order R-09-020-015)

(NASA-CR-75447) Avail: CFSTI CSCL08G

The color photographs from Gemini 4 were taken with a hand held Hasselblad camera with a focal length of 80 mm (f 2.8). The space vehicle was about 180 miles above the surface of the earth when passing over Baja, California and the photographic prints, used in this study, have a scale of about 1:640,000. The photograph selected for the study is essentially vertical, has no obscuring clouds and is centered over a desert area in Baja, California. Geologic features are well displayed. Conventional photogeologic methods were employed to convert the photograph into a geologic map. The major rock units were traced directly from the photograph but the interpretation was made with a stereopair under magnification. Author

**N70-38937*# Geological Survey, Menlo Park, Calif.
RADAR IMAGERY: SALTON SEA AREA, CALIFORNIA**

Edward W. Wolfe Washington May 1966 16 p refs /ts Tech. Letter NASA-29

(NASA Order R-09-020-015)

(NASA-CR-75452) Avail: CFSTI CSCL08G

Radar imagery of the Salton Sea area of southern California was obtained in November 1965. Polarized and depolarized images at a scale of approximately 1:180,000 were studied. Although the two types of imagery are close in quality, the polarized image shows slightly greater tonal contrast and is less obscured by noise, which appears on the depolarized imagery as banding parallel to the line of flight. Segments of the polarized imagery are reproduced. Author

**N70-38938*# Geological Survey, Denver, Colo.
GEOLOGICAL EVALUATION OF RADAR IMAGERY OF THE
SPANISH PEAKS REGION, COLORADO**

Ross B. Johnson Washington Oct. 1966 14 p refs /ts Tech. Letter No. NASA-47

(NASA Order R-09-020-015)

(NASA-CR-78779) Avail: CFSTI CSCL08G

The area of the radar imagery strip extends from Alamosa to Aguilar, Colorado at the latitude of the Spanish Peaks. Inspection of the radar image revealed conspicuous northwest-southeast striking lineaments in Tertiary sedimentary rocks of continental origin. These lineaments do not show on aerial photographs, and were not recognized on the ground during field mapping. Radar imagery, at least of the quality of this strip, does not seem to be adequate for geologic mapping. Flat-lying beds cannot be distinguished from vertical beds; Paleozoic sedimentary rocks, and semi-consolidated Tertiary gravels are not distinctive. Folds and faults, even of regional size, cannot be seen. However, the dikes associated with the Spanish Peaks are well displayed. Radar imagery may be more useful in geomorphic and physiographic investigations. Author

**N70-38939*# Geological Survey, Menlo Park, Calif.
INFRARED IMAGERY OF PART OF THE HIGH CASCADE
RANGE AND MCKENZIE RIVER VALLEY, OREGON**

Donald A. Swanson Jun. 1967 21 p refs /ts Tech. Letter NASA-76

04 GEOLOGY AND MINERAL RESOURCES

(NASA Order R-09-020-015)

(NASA-CR-85276) Avail: CFSTI CSCL08G

Continuous infrared imagery in the 3-5 micron band was obtained by airplane during a south to north overflight on August 14, 1966. The image strip is 3-4 miles wide and extends from 18 miles south of Crater Lake northward to North Sister and McKenzie Pass, where it veers westward and follows McKenzie River as far as its confluence with Willamette River. The infrared imagery is evaluated in terms of physical (principally geologic) and cultural features as portrayed on published geologic maps. The flight was at an altitude of 16,000 feet, and the ground surface varied from a few hundred to over 10,000 feet. The scale of the imagery is approximately 1:81,000 in a direction parallel to the flight path. Normal to the flight path the scale progressively decreases away from the center line of the imagery strip because of the scanning methods. The image is distorted as a consequence of the variable scale, and ground features are foreshortened toward either edge of the recording film. Author

N70-38941*# Geological Survey, Menlo Park, Calif.

GEOLOGIC EVALUATION OF INFRARED IMAGERY OF HIGHLY FAULTED VOLCANIC TERRANE IN SOUTHEAST OREGON

George W. Walker Jun. 1967 19 p refs *Its Tech. Letter NASA-77*

(NASA Order R-09-020-015)

(NASA-CR-85272) Avail: CFSTI CSCL08G

Nearly continuous infrared imagery in the 3-5 micron band, obtained from a single west to east overflight 20-30 miles north of the Oregon border and extending from Grants Pass through the Cascade Range to the Idaho border, is compared empirically with recently prepared geologic maps. Both geologic and cultural features shown on the IR imagery are evaluated and comparisons are made with K band radar imagery of the area near Hart Mountain, Lake County, Oregon. No surface temperature measurements have been made, nor are any data available on the emissivity of the surface materials, so that comparisons and discussion of results are entirely qualitative. Author

N70-38942*# Geological Survey, Washington, D.C.

RADAR IMAGERY: PARMACHENEE LAKE AREA, WEST CENTRAL MAINE

D. S. Harwood Jun. 1967 16 p refs *Its Tech. Letter NASA-81*

(NASA Order R-09-020-015)

(NASA-CR-85279) Avail: CFSTI CSCL08G

Radar imagery was used to study the topography of the Parmachenee Lake area, which extends from the Maine-New Hampshire border northeast along the international border between Quebec and Maine to the Chain Lakes area of Maine. The radar photographs show the influence of resistant bedrock units on topography far better than existing aerial photographs. However, there is no indication that the radar beam can distinguish rock types in any way other than by their topographic expression. There is also little indication that the radar beam can penetrate the dense foliage. However, it is very effective in distinguishing evergreen from deciduous trees. The chief advantages of radar imagery are enhanced topographic expression of resistant bedrock units, continuous strip coverage, and all-weather capability. R.N.A.

N70-38943*# Geological Survey, Menlo Park, Calif.

GEOLOGIC EVALUATION OF RADAR IMAGERY OF THE CENTRAL PART OF THE OREGON HIGH CASCADE RANGE

D. A. Swanson May 1966 19 p refs

(NASA Order R-09-020-015)

(NASA-CR-76691) Avail: CFSTI CSCL08G

Continuous radar imagery was flown in conventional aircraft from about the northern boundary of Crater Lake National Park, Oregon, northward to Black Butte and return. Both like and cross

polarized images were obtained. This report evaluates geologic features shown on the imagery as compared with the known geology shown on published maps, especially in a small (100 mi sq) area of youthful volcanism near South Sister. Author

N70-38945*# Geological Survey, Washington, D.C.

GEOLOGICAL STUDIES OF THE EARTH AND PLANETARY SURFACES OF ULTRAVIOLET ABSORPTION AND SIMULATED LUMINESCENCE

William R. Hemphill and Roger Vickers (IIT Res. Inst., Chicago, Ill.)

Apr. 1966 70 p refs *Its Tech. Letter NASA Suppl-33A*

(NASA Order R-146-09-020-006)

(NASA-CR-75909) Avail: CFSTI CSCL08G

Laboratory and field studies are being conducted to determine the significance of ultraviolet spectral reflectance and stimulated emission measurements in discriminating between surface features and materials, initially from aircraft altitudes, and later from earth and lunar orbit. Laboratory studies have included ultraviolet reflectance and emission measurements of common rocks and rock forming minerals at wavelengths as short as 2200 Å. These studies suggest that although less energy is reflected by some natural materials in the ultraviolet than in the visible spectrum, contrast for some materials imaged at 2500 Å exceeds image contrast of the same materials at longer wavelengths. This work was extended into the vacuum ultraviolet. Airborne tests with an optical-mechanical line scanner equipped with an ultraviolet sensitive photomultiplier detector yielded long wavelength ultraviolet imagery of several geologic and agricultural test sites. Studies outlining constructional and operational constraints of suitable imaging and spectrometer systems for detecting ultraviolet reflectance and luminescence of terrestrial and lunar materials from orbital altitude were completed. R.N.A.

N70-39243*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

GEOMAGNETIC MODELS FROM SATELLITE SURVEYS

Joseph C. Cain Jul. 1970 36 p refs Submitted for publication

(NASA-TM-X-65324; X-645-70-263) Avail: NTIS CSCL08N

Spacecraft experiments measuring magnetic field from a low altitude (below 1500 km) are assessed to determine how well the data have been used to determine numerical models of the internal geomagnetic field. The evidence indicates that surface surveys are no longer needed for defining the broad features of the main field and following secular change. As expected, spacecraft observations are much more comprehensive and quickly obtained, and result in models with higher accuracy. Author

N70-39261# California Univ., Berkeley.

SEISMIC RESPONSE OF SOIL DEPOSITS UNDERLAIN BY INCLINED BOUNDARIES

Houshang Dezfoulian (Ph.D. Thesis) 1969 214 p

Avail: Univ. Microfilms: HC \$9.70/Microfilm \$3.00 Order No. 69-18907

The influence of the rock slope was shown to extend sometimes to as far as 12 times the maximum thickness of the deposit beyond the toe of the rock slope. The extent and the magnitude of the influence was shown to be essentially a function of the combined action of the base slope angle, the maximum thickness of the deposit, the strain-dependent soil properties, and the amplitude and frequency characteristics of the base motion. A method was developed which with the help of diagrams might be used to evaluate the response of soil deposits having inclined rock surfaces by means of a series of semi-infinite solutions. The proposed technique as compared to a finite element method of response analysis is simpler, less expensive, does not require a large-capacity computer, and is reasonably accurate. Finally, the influence of the spatial variations of a traveling wave on the response of a soil deposit was shown to be significant only for low ranges of wave propagation velocities. Dissert. Abstr.

N70-40311*# Geological Survey, Denver, Colo.

GEOLOGIC EVALUATION: RADAR IMAGERY OF TWIN BUTTES AREA, ARIZONA TEST SITE 15

John R. Cooper May 1966 15 p */ts Tech. Letter NASA-28*
(NASA Order R-09-020-015)

(NASA-CR-76004) Avail: NTIS CSCL 08G

Outcrops of glass-rich igneous rock appear as conspicuous dark spots on the depolarized radar image but are obscure on the polarized image and on aerial photographs. Both types of radar imagery clearly outlined an ancient, previously unrecognized flood plain. Author

N70-41074*# Geological Survey, Washington, D.C.

USE OF INFRARED IMAGERY IN STUDY OF THE SAN ANDREAS FAULT SYSTEM, CALIFORNIA

R. W. Wallace and R. M. Moxham Jun. 1966 23 p */ts Tech. Letter NASA-42*

(NASA Order R-09-020-015)

(NASA-CR-76707) Avail: NTIS CSCL 08G

Infrared imagery in the 8 to 13 micron band obtained from aircraft overflights in June 1965 is being used to study the San Andreas fault system in the Carrizo Plain area of California. The fault trace shows clearly over most of the approximately 200-mile length that was flown. Variations in soil moisture caused by the water-barrier characteristics of the fault zone, as well as vegetation differences related to soil moisture and microtopography are factors influencing visibility of the fault in the infrared imagery. Other features that can be identified on the imagery, and which are useful in analyzing offset on the San Andreas fault include: offset segments of ancient stream channels disrupted by movement on the fault, landslide terrain, and numerous soil and Tertiary bedrock units. A Pliocene shale, for example, shows a relatively cool surface as compared to adjacent and nearby bodies of the Santa Margarita Formation and the upper Monterey Shale. Imagery obtained one to two hours before sunrise is considered most useful for the fault studies. Author

N70-41112*# Geological Survey, Washington, D.C.

ANALYSIS OF EARTH ORBITER TEST SITE PROGRAM IN RELATION TO US MINERAL NEEDS

W. D. Carter Aug. 1966 21 p */ts Tech. Letter NASA No. 59*
(NASA Order R-09-020-013)

(NASA-CR-77747) Avail: NTIS CSCL 08G

The objectives, scope, and results of the current NASA Earth Resources Program, specifically its Test Site Feasibility Program, are analyzed in relation to the nation's needs for mineral resources. A list of the mineral commodities in critical shortage was developed and is compared with a list of sites presently under investigation. Author

N70-41115*# Geological Survey, Washington, D.C.

GEOLOGIC INTERPRETATION OF THE GEMINI 5 PHOTOGRAPH OF THE SALT RANGE-POTWAR PLATEAU REGION, WEST PAKISTAN

William R. Hemphill and Walter Danilchik Aug. 1966 22 p */ts Tech. Letter NASA-40*

(NASA Order R-146-09-020-006)

(NASA-CR-77597) Avail: NTIS CSCL 08G

A photograph of the Salt Range and Potwar Plateau region of West Pakistan, taken during the Gemini 5 mission, was evaluated to determine the range of geological and geographic features which can be interpreted from a solitary photograph with a minimum of foreknowledge. The field of view covers about 7000 square miles. The structural features and lithologic information are discussed. It is concluded that some geologic features are more readily recognized and interpreted from a single photograph taken from orbital altitudes than on conventional aerial photographs of larger scale where hundreds of prints are required. Folds and faults were delineated on the basis of rock outcrop pattern, color or tone, and

drainage pattern. Some stratigraphic relationships were also recognized, but specific rock type identification was less conclusive and reliable. N.E.N.

N70-41116*# Geological Survey, Washington, D.C.

PRELIMINARY ULTRAVIOLET REFLECTANCE OF SOME ROCKS AND MINERALS FROM 2000 ANGSTROM TO 3000 ANGSTROM

A. N. Thorpe, C. M. Alexander, and F. E. Senftle Aug. 1966 52 p ref */ts Tech. Letter NASA-37*

(NASA Order R-146-09-020-006)

(NASA-CR-77596) Avail: NTIS CSCL 08G

Initial measurements of solar reflectance to determine the composition of rocks are reported. The rock and mineral specimens were sawed, and one face was cut and polished. Reflectance measurements were made on a 1/2 meter, grating type, McPherson spectrophotometer. A sharp attenuation of reflectance was found in the neighborhood of 1900 Å, and was attributed to the presence of oxygen, mainly in the form of SiO₂. Minerals containing no oxygen showed no such drop. Graphs of the measurements for each specimen are included. N.E.N.

N70-41117*# Geological Survey, Washington, D.C.

GEOLOGICAL EVALUATION OF NIMBUS VIDICON PHOTOGRAPHY, CHESAPEAKE BAY-BLUE RIDGE

Charles R. Lewis and William E. Davies Nov. 1966 11 p ref */ts Tech. Letter NASA-64*

(NASA Order R-09-020-011)

(NASA-CR-80783) Avail: NTIS CSCL 08G

Vidicon photograph 36N284, at a scale of about 1:2,800,000, shows a Mercator effect of scale distortion north and south of the center of the picture. No distinct cultural features can be discerned. Haze and vegetation patterns are dominant. Rocks reflected by vegetation changes can be identified. These include ridges of folded quartzites, the Blue Ridge Complex, and Triassic fault blocks. Deep soils in both the Piedmont and Coastal Plain make it impossible to distinguish the rocks of these areas. Author

N70-41121*# Geological Survey, Flagstaff, Ariz.

RADAR IMAGES: METEOR CRATER, ARIZONA

Gerald G. Schaber Washington Nov. 1966 18 p refs */ts Tech. Letter NASA-62*

(NASA Order R-09-020-015)

(NASA-CR-80642) Avail: NTIS CSCL 08G

Two overlapping strips of radar imagery, covering a total combined area of 460 square miles, centered on Meteor Crater, Arizona, were obtained. The system was a high frequency (K-band), side-looking radar with a multipolarization capability. Two images were recorded simultaneously on each strip. Two separate combinations of transmit and receive polarizations were used for the two flight lines. In Run No. 8, the upper image was produced from the horizontal component of a horizontally transmitted wave; the lower cross polarized image from the vertical component of a horizontally transmitted wave. In Run No. 14, the upper image was produced from the vertical component of a vertically transmitted wave, the lower image was produced from the horizontal component of a vertically transmitted wave. Author

N70-41122*# Geological Survey, Menlo Park, Calif.

EVALUATION OF RADAR IMAGERY OF HIGHLY FAULTED VOLCANIC TERRANE IN SOUTHEAST OREGON

G. W. Walker May 1966 15 p refs */ts Tech. Letter NASA-25*
(NASA Order R-09-020-015)

(NASA-CR-75507) Avail: NTIS CSCL 08G

The synoptic view afforded by the radar image of southeast Oregon is useful in tracing regional structures reflected by topography. Geologic features are generally more apparent on the high contrast polarized image, although several cultural features are more clearly delineated on the depolarized image. Comparison of

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the radar image with conventional high altitude photographs of the same area indicates that the photographs supply considerably more complete and detailed geologic information than does the radar image, perhaps partly because of the appreciable scale difference.

Author

**N70-41126*# Geological Survey, Salt Lake City, Utah.
GEOLOGICAL EVALUATION OF RADAR IMAGERY,
SOUTHWESTERN AND CENTRAL UTAH**

Lowell S. Hilpert Aug. 1966 16 p /*Its Tech. Lett. No. 38*
(NASA Order R-09-020-015)

(NASA-CR-77595) Avail: NTIS CSCL08G

Radar imagery was obtained with a high frequency side-looking radar along three flight lines having an aggregate length of about 650 mi. A selective evaluation indicates the radar imagery might be useful to broadly classify some rock units on the basis of their surficial textures or other characteristics. Tonal contrasts probably represent differences in the degree of soil development, moisture content of the soils, and the vegetative cover. Geologic structures are readily visible in the imagery where they are expressed physiographically and show with about the same clarity as in conventional photography. Subsurface structures without physiographic expression were not observed in the imagery. Railroads clearly show in the radar imagery, but only some roads can be seen. Blacktop roads show as dark lines if they are more than about 30 ft wide. Graded and unimproved dirt roads and blacktop roads less than 30 ft wide can also be detected as light lines where they are flanked by road cuts or earth fills.

Author

**N70-41147*# Geological Survey, Washington, D.C.
GEOLOGIC EVALUATION OF RADAR IMAGERY IN
SOUTHERN UTAH**

R. J. Hackman Nov. 1966 24 p refs /*Its Tech. Letter NASA-58*
(NASA Order R-09-020-015)

(NASA-CR-80782) Avail: NTIS CSCL08G

Radar imagery extending from the Dark Canyon Plateau to Table Cliff Plateau in San Juan and Garfield Counties, Utah was enlarged and compared with conventional aerial photography to determine what geologic features, if any, could be recognized that were not present or were poorly defined on conventional photography. One fault was clearly visible on radar imagery that could only be poorly discerned on conventional photography. Calcareous and gypsiferous sedimentary rocks were shown as very light tones of gray in contrast to darker toned sandstones and shales. Fissile marine shales (dark tones) could be distinguished from sandstone members (light medium tones) and some calcareous beds (light tones). These contrasts were less conspicuous on the conventional aerial photography of the area. On the other hand, many of the rock units, readily distinguishable on the photography, could not be positively differentiated on the radar imagery.

Author

**N70-41177*# Northwestern Univ., Evanston, Ill. Dept. of
Geological Sciences.**

**A SEQUENTIAL LINEAR DISCRIMINANT ANALYSIS
PROGRAM FOR GEOLOGICAL AND REMOTELY-SENSED
DATA**

E. H. Timothy Whitten 15 Jul. 1970 26 p refs
(Grant NGR-14-007-027)

(NASA-CR-113901; Rept-22) Avail: NTIS CSCL08G

A FORTRAN 4 Program for CDC 6400 is presented together with sample output illustrating the use of sequential linear discriminant analysis.

Author

**N70-41659# Nevada Univ., Reno. Mackay School of Mines.
SPECIAL AERIAL PHOTOGRAPHY NEAR THE NEVADA
TEST SITE Final Report**

David B. Slemmons, George E. Brogan, Gary A. Carver, Charles E. Glass, and Robert L. McDonald Jun. 1970 21 p

(Contract AT(26-1)-454; Grant AF-AFOSR-1564)68)

(AD-709735; AFOSR-70-2035-TR) Avail: NTIS CSCL 18/3

The project had two prime purposes: (1) The first objective was to provide geologic and photogrammetric support to the United States Coast and Geodetic Survey, Lamont Geological Observatory, University of Nevada Seismological Laboratory and the Atomic Energy Commission for the Benham underground nuclear test. This support was in the form of large-scale aerial photography and aerial reconnaissance of their survey nets across active faults and any microearthquake arrays with post-test local activity. These photographs were then made available to these organizations or institutions upon request, for precise location and mapping of their nets and arrays. (2) The second objective was to provide large-scale, low sun angle illumination photography of the highly active Winnemucca-Ventura Seismic Zone with special emphasis placed on the Owens Valley, Panamint Valley, Fish Lake Valley, Furnace Creek and Death Valley fault zones along with many other active fault zones located near, but not on the test site. This second objective was to provide before and, if necessary, after aerial photography and ground geological reconnaissance to determine whether any movement along these major active zones was the result of the Benham and other following nuclear tests.

Author (TAB)

**N71-10801# Joint Publications Research Service, Washington,
D.C.**

APPLICATIONS OF SPACE PHOTOGRAPHY IN GEOLOGY

B. V. Vinogradov et al 15 Oct. 1970 15 p refs Transl. into ENGLISH from *Izv. Akad. Nauk SSSR, Ser. Geol. (Moscow)*, no. 1, 1970 p 16-27

(JPRS-51578) Avail: NTIS

Comparative analyses of space photography at a 1:2,000,000 scale and geological maps of Morocco, New Mexico, Arizona, Libya, Tibet, and the high lands of the Sahara are summarized. The effects of vegetation and meteorological conditions on the photointerpretation of geological features in space photographs are discussed as well as the advantages and disadvantages of both aerial and space photography. The analysis of sedimentary, metamorphic, and igneous rock compositions is cited, based on space photography. The use of space photography in studying tectonic structures is mentioned along with suggestions for its use in studies of other geological structures.

J.M.

**N71-11539# Army Cold Regions Research and Engineering Lab.,
Hanover, N.H.**

**THE USE OF AERIAL PHOTOGRAPHY IN
GEOCRYOLOGICAL SURVEYS**

1970 7 p refs Transl. into ENGLISH from the Russian

(AD-711926) Avail: NTIS CSCL 8/2

Advantages of the use of aerial photographic methods in geocryological research are given.

TAB

N71-11985*# Stanford Univ., Calif.

**AIRBORNE INFRARED STUDY OF IGNEOUS ROCKS IN
SONORA PASS TEST SITE**

I. A. Kilinc and R. J. P. Lyon /*n NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 2* 1969 19 p refs

(Contract NAS9-7313)

Avail: NTIS CSCL08G

An aircraft equipped with an infrared pallet consisting of a Lockheed airborne rapid scan IR spectrometer, a Block IR radiometer, a boresight camera, a PRT 5 radiometer, and two RC8 cameras was flown over Sonora Pass and Mono Lake test sites during the period August 27 - 28, 1968. The mission was flown to obtain airborne infrared emission spectra in the 6.76 to 13.33 micron wavelength band, and to discriminate among rock types on the basis of their infrared emission spectra by use of various data processing techniques. The primary objective of the mission was to test the feasibility of using a three-instrument IR pallet together

with the data recording system and to identify the various rock types in selected geologic target areas. The results indicate that certain types of igneous rocks in the test site were identified and contacts between them were determined with about 90% success. However, the airborne infrared emissivity study is limited by the high cost of data collection and processing, by gathering information only along a given flight line, and by dependency of rock type identification on the training spectra taken from the area under study. Author

N71-14758# Hawaii Inst. of Geophysics, Honolulu.
RECONNAISSANCE SAND INVENTORY: OFF LEEWARD OAHU
J. F. Campbell, W. T. Coulbourn, R. Moberly, Jr., and B. R. Rosendahl Jun. 1970 50 p
(Grant NSF GH-28)
(PB-193992: HIG-70-16; SEAGRANT-70-2) Avail: NTIS CSCL 08J

The southern and western coasts of Oahu have been surveyed for shallow-water sand bodies, using a seismic reflection technique. Sand bodies discovered and mapped in water depths of between 60 and 300 feet contain about 370 million cubic yards of sand. Samples from a few locations were of fine-grained calcareous sand that was similar to, but finer than, most Hawaiian beach sands. The reconnaissance survey points to several localities where detailed sampling and mapping are warranted. Author (USGRDR)

N71-15552# Comissao Nacional de Atividades Espaciais, Sao Jose Dos Campos (Brazil).
REMOTE SENSING OF FERRIFEROUS AREAS
Jul. 1970 135 p refs In PORTUGUESE
(LAFE-126) Avail: NTIS

The project to survey the natural resources of Brazil by remote sensors is described. The remote sensing techniques, objectives, and the economic aspects of the program are presented. Data interpretation techniques are also reviewed. Transl. by F.O.S.

N71-15845# Environmental Research Corp., Las Vegas, Nev.
PHOTO INTERPRETATION OF CLOSE-IN PHYSICAL EFFECTS OF AN UNDERGROUND NUCLEAR DETONATION
Frank R. Perchalski Sep. 1970 14 p ref
(NVO-1163-TM-23) Avail: NTIS

Aerial photography provides a quick, economical and accurate technique for determining the surface changes caused by an underground nuclear detonation. Pre-shot and post-shot aerial photography was obtained for the Rulison detonation. These photographs were viewed stereoscopically to assess the surface changes associated with the Rulison detonation. The photo interpretation verified that no massive land slides or rock slides occurred as a result of the event. However, the interpretation revealed that 13 relatively small rock and soil movements occurred within 7 kilometers of ground zero. No information concerning physical effects beyond 7 kilometers is provided. Author (NSA)

N71-16134*# Geological Survey, Washington, D.C.
INFRARED SURVEY OF THE PISGAH CRATER AREA, SAN BERNARDINO COUNTY, CALIFORNIA: A GEOLOGIC INTERPRETATION
Stephen J. Gawarecki In NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 1 1968 38 p refs

(NASA Order R-146)
Avail: NTIS CSCL 08F

Infrared imagery in the 8 micron to 14 micron band of the Pisgah Crater area, California, has provided useful geologic information to complement data obtained from ground studies and from aerial photography. Thermal contrasts representative of those

found through the diurnal cycle were acquired. Among the geologic features shown on the imagery of one or more flight periods were basalt flow contacts where the adjacent flows differed in surface character, distribution of pyroclastics and their alluvial derivatives on the flows, collapsed lava tubes, fissured areas, detail of the Pisgah fault, zonation within Lavic Dry Lake, active drainage on an alluvial fan, and moist areas suggestive of ground-water conditions.

Author

N71-16135*# Geological Survey, Washington, D.C.
THERMAL ANOMALIES AND GEOLOGIC FEATURES OF THE MONO LAKE AREA, CALIFORNIA, AS REVEALED BY INFRARED IMAGERY

Jules D. Friedman In NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 1 1968 76 p refs

Avail: NTIS CSCL 08F

The Mono Lake area, California, was selected for airborne infrared scanning radiometer experiments because of the exposure in this area of a variety of lithologies having different physical and thermal properties, as well as a diversity of textural and morphologic features. The contrasting thermal patterns observed can be grouped as follows: (1) thermal anomalies caused by convective heat loss detected when the temperature difference between the heat source and surrounding terrain was maximal; (2) daytime radiant-temperature differences resulting from variations in the incident radiant solar flux as a function of microrelief and morphology of the surface; and (3) nighttime radiant-temperature differences resulting from contrasts in physical and thermal properties of various lithologic units and water. Author

N71-16136*# Geological Survey, Washington, D.C.
GEOLOGIC EVALUATION OF THERMAL INFRARED IMAGERY, CALIENTE AND TEBLOR RANGES, SOUTHERN CALIFORNIA

Edward W. Wolfe In NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 1 1968 27 p refs

Avail: NTIS CSCL 08F

Thermal infrared imagery obtained in southern California in the pre-dawn and postsunrise hours leads to the following conclusions: (1) the specific gravities of surficial materials influence tonal densities in predawn infrared imagery; (2) geologic interpretation of tonal density patterns is complicated by topographic, atmospheric, and vegetative effects on predawn radiation; (3) geologic features, such as outcrop patterns and some faults, are recognizable in the infrared imagery, as well as in aerial photographs; (4) local radiative anomalies, previously suggested to be caused by the occurrence of groundwater at shallow depths, may be caused by nighttime entrapment of cold air in poorly drained, topographically low areas, and (5) postsunrise infrared imagery is dominated by the preferential warming of slopes exposed to the early morning sun and resembles low-sun-angle photographs. Author

N71-16137*# Geological Survey, Flagstaff, Ariz.
RADAR AND INFRARED IN GEOLOGICAL STUDIES OF NORTHERN ARIZONA

Gerald G. Schaber In NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 1 1968 29 p refs

Avail: NTIS CSCL 08F

Airborne remote radar and infrared sensing data of northern Arizona are summarized and evaluated. Radar imagery furnished useful data in interpretation of tectonics, surface moisture, and overlapping sequences of lava flows. Infrared scanner data provided identification of prehistorical agricultural sites and discrimination between recent dark volcanic ash and lighter, older ash-fall deposits as a function of radiant temperature and possible moisture content. Both sensors did not provide distinctions between rock types.

G.G.

04 GEOLOGY AND MINERAL RESOURCES

N71-16138* Kansas Univ., Lawrence. Center for Research in Engineering Science.

PLUSSES AND MINUSES OF RADAR IN GEOLOGICAL EXPLORATION

L. F. Dellwig *In* NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 1 1968 42 p refs

Avail: NTIS CSCL08G

Aerial radar imagery for geological explorations presents a topography where gross structural and topographic relationships integrate integral and independent features into a regional format; thus, radar is the best sensor for detection, integration, and analysis of lineaments. Its value decreases in small scale studies where polarization and wavelength are of greater significance to detailed geology.

G.G.

N71-16139* Geological Survey, Denver, Colo.

PROGRAM STATEMENT FOR REGIONAL GEOLOGIC STUDIES IN REMOTE SENSING, YELLOWSTONE NATIONAL PARK

Harry W. Smedes *In* NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 1 1968 9 p refs

Avail: NTIS CSCL08F

Remote aerial sensing data obtained by side-looking radar, infrared color photography, ultraviolet scanner, and multiple channel scanner spectrometer are analyzed. It was found that radar images provide good distinctions between bedrock and unconsolidated surface geology. Infrared imagery detected cold emerging springs and traced a fault beneath a lake. The radar image texture made it possible to differentiate between principle areas of rhyolite lava and of rhyolite ash flows. Radar and infrared imagery together provided a good representation of the geological physiography but did not distinguish between rock types and structures.

G.G.

N71-16140* Geological Survey, Menlo Park, Calif.

GEOHERMAL INFRARED ANOMALIES OF LOW INTENSITY, YELLOWSTONE NATIONAL PARK

Donald E. White and Lee D. Miller *In* NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 1 1968 4 p Prepared in cooperation with Colorado State Univ.

Avail: NTIS CSCL08F

Infrared remote sensing of hot springs and other high temperature geothermal phenomena is described. A combination of vertical color photographs, heat flow maps, infrared scanner imagery, apparent surface temperatures, and different temperature interval images was computer evaluated in order to establish the thermal anomalies. Evidence for concealed geothermal reservoirs are temperature gradients and heat flows three to 10 times higher than worldwide averages.

G.G.

N71-16144* Geological Survey, Washington, D.C.

APPLICATION OF ULTRAVIOLET REFLECTANCE AND STIMULATED LUMINESCENCE TO THE REMOTE DETECTION OF NATURAL MATERIALS

William R. Hemphill *In* NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 1968 22 p refs Presented at the 1968 Am. Soc. of Photogrammetry Conv., Washington, D.C., 11-15 Mar. 1968

Avail: NTIS CSCL08G

Outdoor tests of an active ultraviolet imaging system have demonstrated the feasibility of imaging ultraviolet-stimulated luminescence of such minerals as talc, dolomite, and deweylite along quarry faces from distances of several hundred feet. The system features a cathode-ray-tube transmitter, an image-dissector receiver, and a video monitor on which the distribution of luminescent materials is imaged as the out-crop is scanned. A

pulsed ultraviolet laser emitting at 3371 angstroms has been used successfully in the laboratory to stimulate phosphorescence of selected rock and mineral specimens and to discriminate between them on the basis of decay time, which ranges from less than 3 to more than 10 microseconds. Initial results suggest that sodic feldspars have longer decay periods than calcic feldspars. Some granites also appear to have decay periods significantly different from other types of granite in the same locality.

Author

N71-16169* Geological Survey, Washington, D.C.

APPLICATION OF REMOTE SENSING TO OCCURRENCE OF COLLAPSE SINKHOLES IN THE ALAFIA AND PEACE RIVER BASINS, FLORIDA

A. E. Coker *In* NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 3 1968 13 p refs

Avail: NTIS CSCL08F

Techniques are discussed by which sinkhole collapse may be anticipated by using remote sensors to identify, delineate, and study relic features in relation to sinkhole collapse. The recorded data show a correlation between the water level and the aquifer and collapse. The relationship of sinkhole collapse to water resources is considered.

R.B.

N71-19252* Geological Survey, Washington, D.C.

GEOLOGIC APPLICATIONS PROGRAM: SUMMARY OF RECENT PROGRESS AND PLANS

William R. Hemphill *In* NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 1 1969 4 p refs Sponsored in part by NASA

Avail: NTIS HC\$6.00/MF\$0.95 CSCL08G

The progress during FY 1969 and 1970, of the program to evaluate the application of airborne and satellite-borne remote sensing systems to the discrimination and identification of geologic materials is summarized. It is concluded that satellite observation is suited to prospecting for offshore placers as some changes in coastal areas are sufficiently rapid to be observed on repetitive imagery.

F.O.S.

N71-19255* Geological Survey, Washington, D.C.

GEOLOGIC ANALYSIS OF THE X-BAND RADAR MOSAICS OF MASSACHUSETTS

Lincoln R. Page *In* NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 1 1969 19 p refs

Avail: NTIS HC\$6.00/MF\$0.95 CSCL08G

The X-band radar mosaic of Massachusetts, at a scale of 1:500,000, presents an overall view of the geologic and geographic features of the state. Lineament patterns allow recognition of major structural features that can be related by geologists familiar with local areas to faults, joints, folds, and stratigraphy of the bedrock and drumlins, fans, and channels of Pleistocene deposits. More refinement of the method is needed to obtain uniform quality of imagery, correctness of scale, and appropriate orientation of flight lines for maximum use in unknown terrain.

Author

N71-19256* Geological Survey, Denver, Colo.

THERMAL INFRARED INVESTIGATIONS, MILL CREEK AREA, OKLAHOMA

L. C. Rowan, T. W. Offield, Kenneth Watson, R. D. Watson, and P. J. Cannon *In* NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 1 1969 25 p refs

Avail: NTIS HC\$6.00/MF\$0.95 CSCL08G

Thermal-infrared images obtained on flights over the Tishomingo anticline and South Flank near Mill Creek in the Arbuckle Mountains, Oklahoma, were used to study the possibility of identifying some common rock types from their diagnostic reflection

and emission characteristics, and to evaluate the usefulness of infrared images in structural geologic investigations. The areas flown are underlain by folded and faulted Paleozoic dolomite, limestone, sandstone, shale, and Precambrian granite. Images were obtained at 6:00 a.m., 11:00 a.m., and 2:00 p.m. The predawn (6:00 a.m.) image was the most useful in distinguishing rock types. Of particular interest was a thermal contrast of dolomite (warm) and limestone (cool), sufficient to distinguish those rock types and to reveal facies changes between them. Theoretical considerations indicate that this thermal contrast arises from a combination of albedo and thermal-inertia characteristics distinctive of dolomites and limestones in many areas. Author

N71-19259* Geological Survey, Menlo Park, Calif.

GEOLOGIC UTILITY OF SMALL SCALE AIRPHOTOS

Malcolm M. Clark. In NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 1 1969 39 p refs

Avail: NTIS HC\$6.00/MF\$0.95 CSCL08G

The geologic value of small-scale airphotos is emphasized by describing the application of high-altitude oblique and 1:120,000 to 1:145,000 scale vertical airphotos to several geologic problems in California. The examples show the small-scale airphotos can be of use to geologists. High-altitude, high-oblique airphotos show vast areas in one view, including the salient geographic and topographic attributes and many geologic features of an area. Vertical airphotos instantaneously record rapidly changing conditions over large areas, such as tidal flow and surface wind patterns. Author

N71-19260* Kansas Univ., Lawrence. Remote Sensing Lab.

EFFECTIVE RADAR LOOK DIRECTIONS FOR GEOLOGIC INTERPRETATION

H. C. MacDonald. In NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 1 1969 21 p refs

Avail: NTIS HC\$6.00/MF\$0.95 CSCL08G

The availability of multiple flight coverage from eastern Panama and northwestern Colombia has provided sufficient data for a semiquantitative look direction analysis in which the detection of certain geologic features under a variety of terrain conditions was examined. The geologic features selected are faults, joint systems, and dip slopes. Specific examples from those areas of the United States with multiple pass coverage are compared with the data obtained from the Panama imagery, and it is apparent that look direction does influence the detectability of certain geologic features. Depending on the relative topographic relief, effective incidence angle, and look direction, geologic features can be advantageously enhanced or can be completely suppressed. Geological reconnaissance in poorly mapped areas necessitates imaging from four orthogonal look directions to provide maximum terrain information. Where the terrain configuration or structural grain has already been determined, trade-offs between depression angle, range position, and look direction provide near optimum data retrieval with only two imaging passes. Author

N71-21671# Israel Program for Scientific Translations, Ltd., Jerusalem.

AIRBORNE ELECTROPROSPECTING WITH ROTATING MAGNETIC FIELDS

Yu. B. Shaub 1970 189 p refs Transl. into ENGLISH of the book 'Osnovy Aeroelektrorazvedki Metodom Vrashchayushchegosya Magnitnogo Polya' Leningrad, Geostoptekhnizdat., 1963 Sponsored by ESSA and NSF.

(TT-70-50059) Copyright Avail: NTIS

Airborne electroprospecting using rotating magnetic fields is systematically presented. Calculations are given regarding the anomalous effects of a conductive medium and bodies of regular form, field and laboratory measuring equipment and methods are described, and results of field work are summarized. In addition many general topics connected with modern airborne methods are

discussed, such as the efficiency of the various versions of airborne prospecting, noise immunity of the applicable measurement systems, distortion of the anomalies by the inertia of measuring instruments, detection of the useful signals against strong noise background, application of correlation analysis to processing the data. Author

N71-22053# Joint Publications Research Service, Washington, D.C.

TERRESTRIAL GEOPHYSICS

In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 247 1 Mar. 1971 p 31-40

Avail: NTIS

A light weight seismic station developed for remote recording is briefly discussed, along with vertical derivative determination of gravity potential, using a horizontal gradientometer. Measuring geomagnetic components from moving platforms and seismic station recordings at Stocki on 27 January 1971 are examined. Abstracts on various geophysical literature are also presented, including seismic studies in coastal regions, crustal structure investigations from surface wave dispersion, and absorption and resistivity of rocks in ore deposits. J.A.M.

N71-23522# Colorado School of Mines, Golden. Dept. of Geophysics.

EVALUATION OF AIRBORNE ELECTROMAGNETIC SURVEYING FOR MAPPING VARIATIONS IN ROCK STRENGTH Final Report, 1 Mar. 1969-1 Jul. 1970

George V. Keller, Andre B. Lebel, and Evan L. Ausman, Jr. 1 Dec. 1970 70 p refs

(Contract F19628-69-C-0281)

(AD-718438; AFCRL-70-0701) Avail: NTIS CSCL 8/7

The objective of the report is to determine the feasibility of estimating variations in ground strength on the basis of electrical conductivities measured from the air. A review of the literature indicates that for a wide variety of crystalline igneous rocks, a reasonably unique relationship should exist between resistivity and strength. Three airborne electromagnetic surveying techniques hold promise for measuring ground conductivity in the desired range. These are, in order of the ease with which surveys might be made with existing or modified systems, the wave-tilt method, the long-grounded-wire method and the INPUT method. The wave-tilt method makes use of waves radiated by VLF broadcast stations in the frequency range from 15 to 30 KHz, and is useful with no modification of commercially available equipment, as field tests described in this report indicate. The long-grounded-wire method makes use of fields from a current-carrying cable installed specifically for a survey. The INPUT method makes use of a transmitter carried on the aircraft with the receiver. However, in order to measure conductivities in the range of interest with the existing commercial INPUT system, major modifications would be required. Author: (GRA)

N71-26644# Geological Survey, Washington, D.C.

GEOLOGICAL SURVEY RESEARCH 1970, CHAPTER D

1970 321 p refs /Its Geol. Surv. Profess. Paper 700-D

Avail: SOD \$3.75

The scientific and economic results of geologic, hydrologic, and topographic studies are reported. Articles on the following subjects are included: structural geology, stratigraphy, paleontology, paleogeomorphology, geochronology, geochemistry, geophysics, economic geology, mineralogy and petrology, analytical methods, instruments and techniques, astrogeology, surface water, ground water, relation between ground water and surface water, geochemistry of water, salt water intrusion, waste disposal, and an evaluation of analog techniques for image registration. F.O.S.

04 GEOLOGY AND MINERAL RESOURCES

N71-26645# Geological Survey, Denver, Colo.

APOLLO 7 PHOTOGRAPHY IN ANTOFAGASTA PROVINCE, CHILE: AN INTERPRETATION

Kenneth Segerstrom *In its* Geol. Surv. Res. 1970, Chapter D 1970 p D10-D17 refs

Avail: SOD \$3.75

As a result of 1969 field checking of Apollo 7 (October 1968) color photography of northern Chile, photographic tonal values were correlated with the natural colors of surficial deposits and rock of the Salar de Atacama area. An east-west linear feature on Apollo 7 photographs of the Taltal-Salar de Gorge area defies field identification because it is largely concealed by sedimentary and volcanic deposits. This feature is interpreted as a transverse fracture which has been inactive since Jurassic time. Fragmental evidence from Peru and central Chile indicates that despite its poor visibility on the ground and on conventional aerial photographs, an ancient structural trend transverse to the modern circum-Pacific trend is real, and its distribution is broader than has hitherto been recognized. Author

N71-26647# Geological Survey, Washington, D.C.

CHANGING PATTERNS OF THERMAL EMISSION FROM SURTSEY, ICELAND, BETWEEN 1966 AND 1969

Jules D. Friedman and Richard S. Williams, Jr. (AFCRL, Bedford, Mass.) *In its* Geol. Surv. Res. 1970, Chapter D 1970 p D116-D124 refs Sponsored in part by AFCRL, Bedford, Mass. and Iceland Natl. Energy Authority

Avail: SOD \$3.75

A comparison is presented of the August 1968 aerial infrared images of Surtsey, Iceland, with 1966 aerial infrared survey data which indicates continued but generally diminishing thermal emission following cessation of effusive activity in mid-1967. Emission from most but not all secondary or rootless sources including flow fractures, collapse features, and secondary fumaroles diminished more rapidly than from primary convecting structures, notably ring fractures associated with the Surtur II vent, and linear structures related to faults which controlled various phases of eruptive activity between 1964 and 1967. However, thermal emission increased in 1969 from the Surtur I and II tephra rims. Heat flux from the tephra anomalies is estimated at greater than 1,500 microcal/sq cm/sec and is dominantly convective. Heat flux from the primary convecting structures may be an order of magnitude greater, suggesting a total heat transport to the surface of the island of 10 to the 9th power to 10 to the 10th power microcal/sec in 1969, less than 1 percent of the peak heat transport during the effusive eruption phase. Author

N71-26648# Geological Survey, Denver, Colo.

INDUCED POLARIZATION AND RESISTIVITY SURVEYS ON CLEARY SUMMIT, ALASKA

Lennart A. Anderson and Gordon R. Johnson *In its* Geol. Surv. Res. 1970, Chapter D 1970 p D125-D128 refs

Avail: SOD \$3.75

Induced polarization and resistivity surveys are presented which were made on the north flank of Cleary Summit about 16 air miles north-northeast of Fairbanks, Alaska. Data were obtained along three traverses that were positioned to transect some of the known vein structures that have produced gold, silver, and other metallic minerals. Two disseminated sulfide concentrations of possible economic interest, one deep seated and the other about 75 to 150 feet beneath the surface, were detected. Author

N71-26649# Geological Survey, Denver, Colo.

GEOLOGIC INTERPRETATION OF A RESIDUAL AEROMAGNETIC MAP OF THE NIXON FORK DISTRICT, ALASKA

Lennart A. Anderson, Bruce L. Reed, and Gordon R. Johnson *In its* Geol. Surv. Res. 1970, Chapter D 1970 p D129-D133 refs

Avail: SOD \$3.75

A residual aeromagnetic map covering approximately 480 square miles was compiled for the Nixon Fork district located about 35 miles northeast of McGrath, Alaska. The aeromagnetic survey was flown in search of concealed intrusive rocks similar to the quartz monzonite stocks that have produced contact metamorphic deposits in limestone, the principal source of gold in the district. Negative magnetic anomalies are associated with quartz monzonite stocks, establishing a useful criterion for locating favorable prospecting areas. Some new localities of possible economic interest in this area are discussed. Author

N71-27604*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

MAGNETOSPHERIC FIELD DISTORTIONS OBSERVED BY OGO'S 3 AND 5

M. Sugiura, B. G. Ledley, T. L. Skillman, and J. P. Heppner May 1971 44 p refs

(NASA-TM-X-65563; X-645-71-203) Avail: NTIS CSCL 038

Magnetospheric field distortions are studied using approximately 10,000 data points sampled from the rubidium magnetometer measurements on OGO's 3 and 5. Analysis is made in terms of Delta B defined as the observed field magnitude minus the magnitude of a reference geomagnetic field. Average contours of equal Delta B are shown in the geomagnetic noon-midnight and dawn-dusk meridian planes for magnetically quiet and slightly disturbed conditions. These Delta B contour maps show (a) a high latitude + Delta B region on the night side and (b) an equatorial - Delta B region in the inner magnetosphere. The high latitude + Delta B region extends toward the dayside magnetosphere beyond dawn and dusk with decreasing magnitude of Delta B. Though the observations presented here do not cover southern high latitudes at appropriate geocentric distances to directly detect a southern counterpart of the + Delta B region, there is no indication in the available data to suggest absence of a similar region in the southern hemisphere. Region (b), also, the equatorial - Delta B region encircling the earth, shows greater inflation of the inner magnetosphere during magnetically quiet periods than the inflation usually assumed. Author

N71-28268# Shell Exploration and Production Lab., Rijswijk (Netherlands).

ANALYSIS OF ELECTROMAGNETIC PROSPECTING DATA BY MEANS OF APPARENT WAVE NUMBERS

Petrus Johannes Maria Thomeer (Ph.D. Thesis, Tech. Hogeschool Delft) 1970 115 p refs

Avail: NTIS

The disturbing influence on applied magnetic fields caused by the electrical properties of subsurface rocks is investigated by means of an apparent wave number, from which the components of the electromagnetic field strength for an inhomogeneous surface such as a multilayer structure can be computed. The influence of the structure, caused by the electrical properties of the layers, on the magnitude of the measured field strength is analyzed. ESRO

N71-30177*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

A COMPARATIVE GEOLOGIC STUDY OF SPACECRAFT AND AIRCRAFT IMAGERY

H. W. Blodgett May 1971 62 p refs

(NASA-TM-X-65594; X-644-71-204) Avail: NTIS CSCL 08G

A comparative study of five areas of northwest Saudi Arabia was conducted using five scales (1:18 million to 1:60,000) and types of imagery, and employing standard photo interpretation techniques. Results indicate that each type imagery is uniquely suited for investigation of a specific class of geologic problem. For study of small geologic detail and construction of precise maps, aerial photography is unexcelled. Mosaics permit extrapolation of

inferences from individual photographs to larger areas, but with loss of detail. Orbital color photography appears to combine many advantages of mosaics and air photographs, for despite its low ground resolution, it is clearly valuable for studying regions of subcontinental size. When rectified, resolution on synoptic photographs is degraded, but the resultant near-vertical projection enables more accurate correlation of data between the unrectified photography and standard geologic map formats. Orbital scan-type imagery has very low ground resolution and may not be directly useful in geologic research. It does, however, provide a useful view of continental and intercontinental structural relationships. Author

N71-30841# Royal Swedish Academy of Engineering Sciences, Stockholm.

OREGEOLOGY IN THE FUTURE [MALMGEOLOGIEN INFOER FRAMTIDEN]

Arne S. Lundberg *In its Articles and Speeches at the Anniv. of IVA, 1919-1969* 1969 p 214-221 In SWEDISH

Avail: NTIS: Esselte AB, Stockholm: 18 SKR

Ore prospection from satellites is one of the fascinating possibilities offered by the space age, but prospection of the so far known earth resources demands a geological basic research, called by the author "oregeology. This demands new initiative for it means building a bridge over the gap between basic sciences and the economical goals. ESRO

N71-31830*# Computer Sciences Corp., Falls Church, Va.
COMPARISON OF THE SAO-1969 GRAVITY FIELD WITH SURFACE GRAVITY

William E. Strange *In NASA. Goddard Space Flight Center Proc. of the GEOS-2 Program Rev. Meeting, Vol. 1* Nov. 1970 p 89-98 refs

Avail: NTIS HC\$8.00/MF\$0.95 CSCL08E

A study was conducted to carry out a more critical comparison of the Smithsonian Astrophysical Observatory (SAO) 1969 gravity field representation and surface gravity than those previously reported in order to better establish the degree of accuracy of the SAO results. It has been generally felt that the accuracy with which the SAO 1969 solution represented average values of gravity over areas of dimensions of approximately 11 deg by 11 deg was about 8 to 10 mgals. However, results obtained in the present study indicate that this accuracy is more nearly in the range of + or - 4 to + or - 6 mgals. D.L.G.

N71-32180*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

DERIVATION OF THE INTERNATIONAL GEOMAGNETIC REFERENCE FIELD, IGRF(10/68)

Joseph C. Cain and Shirley J. Cain Washington Aug. 1971 38 p refs

(NASA-TN-D-6237; G-1023) Avail: NTIS CSCL20C

The results are summarized of the testing of the various magnetic field models against the available World Magnetic Survey data and describes the method by which the first International Geomagnetic Reference Field [IGRF(10/68)] was derived. The IGRF(10/68) was composed of contributions from the field models derived by Goddard Space Flight Center, Air Force Cambridge Research Laboratories, Royal Greenwich Observatory, Institute of Terrestrial Magnetism and Radiowave Propagation (IZMIRAN), and the U.S. Coast and Geodetic Survey. IGRF(10/68) is a set of 80 internal, spherical harmonic coefficients and their first time derivatives, epoch 1965.0, referenced to a sphere of radius 6371.2 km. The rms residuals to surface and airborne magnetic-survey data taken between 1961 and 1965 average approximately 200 gamma. The rms deviations from selected Cosmos 49 (1964.7) and POGO (1965.8-1967.9) satellite observations of total field range from 30 gamma to 60 gamma. Author

N71-32418# Aerojet-General Corp., El Monte, Calif. Microwave Div.

A STUDY OF PASSIVE MICROWAVE TECHNIQUES APPLIED TO GEOLOGIC PROBLEMS Final Report, 1969-1970

A. T. Edgerton and D. T. Trexler Jul. 1970 268 p refs

(Contract DI-14-08-0001-11983)

(PB-198378; AGC-1361R-1; USGS-GD-71-012) Avail: NTIS CSCL08G

The microwave properties of representative rocks and minerals are established and the possibility of using microwave radiometry for various geologic mapping problems is examined. Field investigations, conducted at numerous sites in the western United States, were performed with the use of a mobile field laboratory equipped with four dual-polarized radiometers operating at wavelengths 0.81, 2.2, 6.0, and 21 cm. The microwave brightness temperature measurements were used to determine the emissivities of several common rocks and minerals. Correlation was noted between the computed emissivities and physical characteristics of the materials, but no direct association was noted between the chemical composition of target materials and the computed emissivities. GRA

N71-33185*# Geological Survey, Denver, Colo.

GEOLOGIC INTERPRETATION OF A RADAR MOSAIC OF YELLOWSTONE NATIONAL PARK

Harold J. Prostka Feb. 1970 16 p refs

(NASA Order W-12589)

(NASA-CR-121425; Rept-179) Avail: NTIS CSCL171

A radar mosaic of the Yellowstone National Park area depicted the topographic and surface textural features of five major rock units and structural features well enough that a fairly accurate generalized geologic map could be drawn. Correct rock units were shown in 70 percent of the area of this interpretive map. Interpretive errors resulted in the areas where diagnostic features were masked by surficial deposits or were modified by glacial scour or young faults. Author

N71-33374*# Geological Survey, Denver, Colo.

GEOLOGIC EVALUATION OF ANOMALIES BETWEEN LIKE-POLARIZED AND CROSS-POLARIZED K-BAND SIDE-LOOKING RADAR IMAGERY OF YELLOWSTONE NATIONAL PARK, 1965

Gerald M. Richmond [1970] 35 p refs

(NASA Order W-13165)

(NASA-CR-121419; NASA-185) Avail: CSCL08E

Surface geology anomalies noted between like-polarized and cross-polarized side-looking K-band radar imagery recorded over Yellowstone National Park and the northern part of Grand Teton National Park are analyzed. The imagery was flown in the fall of 1965. The flight strips are in a generally north-south direction and the direction of view is to the east and west alternately. Author

N71-34399# Joint Publications Research Service, Washington, D.C.

TELEPHOTOGRAPHS OF THE EARTH FROM SPACE

I. Bashilova 31 Aug. 1971 7 p Transl. into ENGLISH from Nauka Zhizn (USSR), no. 7, 1971 p 44-47

(JPRS-53949) Avail: NTIS

An overview is presented of the benefits that geologists have derived from space transmitted television photographs of the earth. It is pointed out that, in addition to the fact that they provide a tremendous field of view, the TV photographs from space have the property of a natural generalization of the objects which are being reflected. Numerous incidents are cited in which questions, relating to geological phenomena throughout the world, have been resolved through interpretation of space transmitted telephotos. D.L.G.

04 GEOLOGY AND MINERAL RESOURCES

N71-35516* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GEOLOGICAL USE OF EARTH-ORBITAL PHOTOGRAPHY
Paul D. Lowman, Jr. Aug. 1971 38 p refs Presented at the 22d Intern. Astronautical Congr., Brussels, Sep. 1971
(NASA-TM-X-65682; X-644-71-359) Avail: NTIS CSCL 14E

The geologic applications of orbital photography are reviewed with four case histories of such applications. These case histories include discovery of unmapped faults in southern California, discovery of an unmapped volcanic field in northern Mexico, the finding of evidence that so-called Texas lineament is a broad zone of folding and dip-slip faulting, and the demonstration of the great importance of wind erosion as a land-sculpturing agent in North Africa. These examples show the advantages of orbital photography over aerial photography to be: (1) large area per picture, (2) adaptability to direct study of large areas by individual geologists, (3) coverage of areas inaccessible to aerial photography, (4) global coverage, and (5) availability and economy of color and multispectral coverage. Orbital photographs are also used to check the accuracy of existing geologic maps, to compare the geology and geomorphology of widely separated areas, and to study specific geologic problems involving large areas. Author

N72-12259* Geological Survey, Denver, Colo.
LINEAR GEOLOGIC STRUCTURE AND MAGIC ROCK DISCRIMINATION AS DETERMINED FROM INFRARED DATA

T. W. Offield, L. C. Rowan, and R. D. Watson In NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 12 p refs

Avail: NTIS CSCL 08G

Color infrared photographs of the Beartooth Mountains, Montana show the distribution of mafic dikes and amphibolite bodies. Lineaments that cross grassy plateaus can be identified as dikes by the marked contrast between the dark rocks and the red vegetation. Some amphibolite bodies in granitic terrain can also be detected by infrared photography and their contacts can be accurately drawn due to enhanced contrast of the two types of rock in the near infrared. Reflectance measurements made in the field for amphibolite and granite show that the granite is 25% to 50% more reflective in the near infrared than in the visible region. Further enhancement is due to less atmospheric scattering than in the visible region. Thermal infrared images of the Mill Creek, Oklahoma test site provided information on geologic faults and fracture systems not obtainable from photographs. Subtle stripes that cross outcrop and intervening soil areas and which probably record water distribution are also shown on infrared photographs. Author

N72-12260* Geological Survey, Denver, Colo.
MULTISPECTRAL ANALYSIS OF LIMESTONE, DOLOMITE, AND GRANITE, MILL CREEK, OKLAHOMA

L. C. Rowan and Kenneth Watson In NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 114 p refs

Avail: NTIS CSCL 08G

Spectral reflectance and thermal emission data were collected at the Mill Creek, Oklahoma test site during NASA missions 132 and 133 in June 1970. The data were collected by three aircraft flown several times during the diurnal cycle at altitudes of 150 to 17,000 m above mean terrain. Reflectance of the main rock types (limestone, dolomite, and granite) was determined from the data collected using a 12-channel multispectral scanner during mission 133 and from thermal infrared images recorded during mission 132 on an RS-7 scanner from 17,000 m above terrain. A preliminary rock recognition map was generated automatically using data collected from 900 m above terrain. The discrimination provided by the map is reasonably accurate. Misidentification occurred in areas of unusually high dolomite reflectivity. High altitude thermal infrared (10 to 12 micrometers) images show regional folds and faults distinguished by the presence of thermally contrasting materials. Linear and curvilinear structural features two to three times smaller than the nominal 17 m resolution could be detected. Author

N72-12262* Aerojet-General Corp., El Monte, Calif. Microwave Div.

A STUDY OF PASSIVE MICROWAVE TECHNIQUES APPLIED TO GEOLOGIC PROBLEMS

A. T. Edgerton In NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 12 p

Avail: NTIS CSCL 08G

Passive microwave techniques were applied to geologic problems, in order to establish the microwave properties of representative rocks and minerals, and to examine the feasibility of using microwave radiometry for geologic mapping problems. A review of microwave pertaining to geology was conducted, coupled with laboratory and field investigations of the microwave emission characteristics of various geologic features. The laboratory studies consisted of dielectric constant measurements of rocks and minerals. A majority of field investigations conducted in the western United States, involved the microwave emission characteristics of rock types, and a portion of the study was concerned with microwave properties of mineralized areas. Experiments were also conducted in the vicinity of a coal seam fire in Colorado and across the San Andreas Fault Zone near the Salton Sea, in Southern California. Author

N72-12263* Geological Survey, Washington, D.C.
GEOLOGIC INTERPRETATION OF APOLLO 6 STEREO- PHOTOGRAPHY FROM BAJA CALIFORNIA TO WEST TEXAS

Stephen J. Gawarecki In NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 25 p refs

Avail: NTIS CSCL 08G

Excellent space photography of parts of the southwestern United States and northwestern Mexico was obtained during the unmanned Apollo 6 spaceflight. Two features of this photography made it useful for geologic interpretations: its vertical stereocoverage and its exposure under a relatively low angle of solar illumination through an unusually cloud-free and clear atmosphere. The structural patterns, which were topographically enhanced by the longer shadows, were annotated on the photographs, in order to analyze their trends with respect to the continental tectonic framework, and to attempt to correlate the pattern with known copper or other base metal deposits. The annotated fracture patterns showed the regional trends and their distribution. The area studied was a 100- to 105-mile swath of terrain covering a total land area of approximately 60,000 square statute miles. The coverage began from a point centered on Punta Colnett on the Pacific coast of Baja California and extended to the Sacramento Mountains of New Mexico and west Texas. Author

N72-12323* Iowa State Univ. of Science and Technology. Ames. Science and Humanities Research Inst.

A SEISMIC SURVEY OF THE MANSON DISTURBED AREA Final Report

PHERIC MOISTURE FOR ITS USE IN A CLOSED ECOLOGICAL SYSTEM

G. P. Khomchenko, S. V. Chizhov, Yu. Ye. Sinyak, V. F. Stolbov, M. I. Shikina, and V. V. Krasnoshchekov 17 Nov. 1971 9 p refs Transl. into ENGLISH from Izv. Timiryazevskoy, Selsko-Khozyaystvennoy Akad. (Moscow), no. 5, 1971 p 184-190

(JPRS-54502; UDC-613.693:628.16.0809; CSO-0929/72-W) Avail: NTIS

Various techniques for retrieving atmospheric humidity condensates for use in life support systems are examined. The feasibility of using the organic and inorganic condensates as drinking water and preparing feed solutions for growing higher and lower plants on prolonged space flights is also discussed. Biological and toxicological evaluation of the recovered water indicates that it can be used for the above purposes. E.H.W.

N72-12328* Aerojet-General Corp., El Monte, Calif. Microwave Div.

MICROWAVE RADIOMETRIC INVESTIGATIONS OF MINE

SUBSIDENCE IN ROCK SPRINGS, WYOMING Final Report

A. T. Edgerton, F. Ruskey, and D. N. Williams Jan. 1971 96 p
 refs Sponsored by NASA
 (Contract BM-HO-110156)
 (NASA-CR-123480; Rept-1721-2;
 NASA-Task-160-75-73-04-10; IR-USGS-217) Avail: NTIS
 CSCL 08G

Investigations were made in two areas where mapping techniques are needed for locating abandoned coal mines and subsidence-prone areas. Microwave surveys were conducted specifically to map the overburden moisture distribution resulting from the subsurface geology. The microwave radiometric maps and supporting data were analyzed in terms of both surface and subsurface phenomena, and were compared with the available subsurface information. Data from the 21 cm line showed better response to subsurface conditions and were used for all detailed sensor analyses. Preferential distribution of near-surface moisture was observed on both sites. A major subsurface feature was located that extended more than 750 feet. This feature exhibited a positive microwave signature that correlates closely with a large haulage tunnel in the No. 7 coal seam, which occurs at a depth of 160 feet. At this location there is no surface evidence of subsidence and the anomaly is believed to be associated with active subsidence which has not reached the surface. Several other anomalies were attributed to factors unrelated to mining activities or subsidence. Author

N72-12329*# Earth Satellite Corp., Washington, D.C. REMOTE SENSING FOR MINED AREA RECLAMATION: APPLICATION INVENTORY

1 Jun. 1971 40 p ref Sponsored by NASA
 (NASA-CR-124608; NASA-Task-160-75-73-04-10;
 IR-USGS-218) Avail: NTIS CSCL 08G

Applications of aerial remote sensing to coal mined area reclamation are documented, and information concerning available data banks for coal producing areas in the east and midwest is given. A summary of mined area information requirements to which remote sensing methods might contribute is included. Author

N72-14337 Department of Energy, Mines and Resources, Ottawa (Ontario).**RESOURCE SATELLITES AND REMOTE AIRBORNE SENSING FOR CANADA. REPORT NO. 6: GEOLOGY**

Dennis White, ed. 1971 43 p ref
 (M75-2/6) Copyright. Avail: Issuing Activity

The use of remote sensors in Earth Resources Technology Satellites and other unmanned satellites to observe and report on Canadian geological formations is discussed. The potential of remote sensing from both high and low altitudes is investigated and geological applications that could be improved, augmented, or replaced by remote sensing technology are described. A program to develop the equipment and techniques for conducting aerial reconnaissance of earth resources is recommended. Author

N72-14400# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.**GEOMAGNETIC FIELD OF THE BLACK SEA BASIN**

Ya. P. Malovitskii, B. D. Uglov, and G. V. Osipov 26 Jul. 1971 21 p refs Transl. into ENGLISH from Geofiz. Sb., Akad. Nauk Ukr. SSR, Inst. Geofiz. (Kiev), no. 32, 1969 p 28-38 (AF Proj. M122)
 (AD-730077; FTD-HC-23-368-71; UR/0000-69-000-032) Avail: NTIS CSCL 08/14

Observations were made with a sea proton magnetometer along meridional profiles; the average distance between profiles was about 28 km. On some profiles special echo sounders were employed for highly precise depth measurements. Horizontal control of the profiles was with an RSVT-1 radiogeodetic system, as well as by navigation and astronomical methods. Survey data were used in compiling a map of given magnetic field anomalies for a large part of the Black Sea. Five large zones were defined which differ in amplitude, periods and strike of anomalies.

Quantitative computations of the parameters of magnetically disturbing bodies were made for determining the geologic nature of 14 anomalies. Comparison of these data with deep seismic sounding data indicates an adequate reliability of determining depth to the upper surface of disturbing bodies. Author (GRA)

N72-16110# Army Engineer Topographic Labs., Fort Belvoir, Va.**THE USE OF COLOR AERIAL PHOTOGRAPHY IN THE RECONNAISSANCE OF SOILS AND ROCKS** c14

Abraham Anson In AGARD Propagation Limitations in Remote Sensing Oct. 1971 10 p refs
 Avail: NTIS HC \$6.00/MF \$0.95

A specialized interpretation of soils and rocks can be obtained from aerial photography in color. In using aerial color film, the three-layer emulsion presents a more readily understood spectral relationship than can be obtained from black-and-white film; the reconnaissance of inaccessible areas with their rock structures is more rapidly analyzed than solely by ground exploration. Geologists analyze soil conditions using 1:20,000-scale aerial color and infrared photographs together with sparse generalized ground information. Author

N72-18352*# Geological Survey, Flagstaff, Ariz. GEOLOGIC EVALUATION OF REMOTE SENSING DATA, SITE 157, AWZA-BORREGO DESERT, CALIFORNIA

Edward W. Wolfe Mar. 1969 61 p refs
 (NASA Order R-09-020-011)
 (NASA-CR-125650; USGS-IR-NASA-144) Avail: NTIS
 CSCL 08G

Remote sensing data were obtained at site 157 in May 1968 under mission 73 of the NASA aircraft program. The site is located in an area of high temperatures and extreme aridity immediately west of the Imperial Valley, Southern California. Site 157 is partially surrounded by pre-Cenozoic crystalline rocks exposed in the Fish Creek, Vallecito, and Tierra Blanca Mountains. The study area itself is underlain by more than 20,000 feet of sedimentary strata of late Cenozoic age. Author

N72-18355*# Geological Survey, Menlo Park, Calif. GEOLOGIC UTILITY OF SMALL-SCALE AIRPHOTOS

Malcolm M. Clark 1969 73 p refs
 (NASA Order T-80485)
 (NASA-CR-125656; USGS-IR-NASA-161) Avail: NTIS
 CSCL 08G

The geologic value of small scale airphotos is emphasized by describing the application of high altitude oblique and 1:120,000 to 1:145,000 scale vertical airphotos to several geologic problems in California. These examples show that small-scale airphotos can be of use to geologists in the following ways: (1) high altitude, high oblique airphotos show vast areas in one view; and (2) vertical airphotos offer the most efficient method of discovering the major topographic features and structural and lithologic characteristics of terrain. Author

N72-18356*# Geological Survey, Denver, Colo. GENERALIZED GEOLOGIC EVALUATION OF SIDE LOOKING RADAR IMAGERY OF THE TETON RANGE AND JACKSON HOLE, NORTHWESTERN WYOMING

J. D. Love Feb. 1970 25 p refs
 (NASA Order R-09-020-011)
 (NASA-CR-125646; USGS-IR-NASA-168) Avail: NTIS
 CSCL 08G

A generalized geologic evaluation of lines, localities, and features of various types that are visible on a series of radar image strips covering the Teton Range and Jackson Hole in northwestern Wyoming, is given. No attempt was made to collate a complete geologic map with the radar image at each locality. Formation names, problems of geologic interpretation, and details of stratigraphy and structure that are not directly pertinent to a study of the imagery are omitted, but reference is made to publications that contain this type of supplementary information. Author

04 GEOLOGY AND MINERAL RESOURCES

N72-18447* Geological Survey, Menlo Park, Calif.
MULTISPECTRAL TECHNIQUES FOR GENERAL GEOLOGICAL SURVEYS EVALUATION OF A FOUR-BAND PHOTOGRAPHIC SYSTEM
Dwight Crowder, F. May 1969 14 p refs
(NASA Order R-090-020-011)
(NASA-CR-125641; USGS-IR-NASA-150) Avail: NTIS
CSCL 14B

A general geological survey at 1:62,500 scale of the well exposed rocks of the White Mountains and the adjacent volcanic desert plateau is reported. The tuffs, granites, sedimentary rocks and metavolcanic rocks in this arid region are varicolored and conventional black and white aerial photographs have been a useful mapping aid. A large number of true color and false color aerial photographs and multispectral viewer screen images of the study area are evaluated in order to consider what imagery is the most useful for distinguishing rock types. Photographs of true color film are judged the most useful for recognizing geographic locations. Author

N72-18449* Geological Survey, Menlo Park, Calif.
EVALUATION OF NINE-FRAME ENHANCED MULTIBAND PHOTOGRAPHY SAN ANDREAS FAULT ZONE, CARRIZO PLAIN, CALIFORNIA
Robert E. Wallace [1969] 14 p Original contains color illustrations
(NASA Order R-09-020-011)
(NASA-CR-125633; USGS-IR-NASA-18) Avail: NTIS
CSCL 14E

Nine-frame multiband aerial photography of a sample area 4500 feet on a side was processed to enhance spectral contrasts. The area concerned is in the Carrizo Plain, 45 miles west of Bakersfield, California, in sec. 29, T 31 S., R. 21 E., as shown on the Panorama Hills quadrangle topographic map published by the U. S. Geological Survey. The accompany illustrations include an index map showing the location of the Carrizo Plain area; a geologic map of the area based on field studies and examination of black and white aerial photographs; an enhanced multiband aerial photograph; an Aero Ektachrome photograph; black and white aerial photographs; and infrared image in the 8-13 micron band. Author

N72-18452* Geological Survey, Menlo Park, Calif.
EVALUATION OF COLOR AND COLOR INFRARED PHOTOGRAPHY FROM THE GOLDFIELD MINING DISTRICT, ESMEERLDA AND NYE COUNTRIES, NEVADA
Roger P. Ashley Mar. 1970 56 p refs Original contains color illustrations
(NASA Order R-09-020-015)
(NASA-CR-125655; USGS-IR-NASA-176) Avail: NTIS
CSCL 14E

The determination of geological features characteristic of the Goldfield epithermal ore deposits is considered and which of them can be identified from color and color infrared aerial photography. The Goldfield mining district in the western part of the Basin and Range Province is the area of study, located in desert terrain of relatively low relief. Author

N72-21362# Bureau of Mines, Washington, D.C.
MINES BUREAU SAYS SURFACE MINING MIGHT BE CHECKED FROM SPACE PHOTOGRAPHS News Release
Bender 12 Apr. 1972 2 p ref
Avail: Issuing Activity

The use of satellite photographs for monitoring mining operations is proposed. Open pit copper mining data were obtained from photographs taken by Gemini 5, Apollo 6, and Apollo 9 flights. Photointerpretation procedures to identify solid waste disposal and mined land mined land restoration activities are described. The application of spaceborne photography as a method for solving environmental problems is recommended. Author

N72-21364* Translation Consultants, Ltd., Arlington, Va.
INTERPRETATION OF AERIAL PHOTOGRAPHS FOR GEOMORPHOLOGICAL RESEARCH
Ye. N. Azbukina Washington NASA Apr. 1972 86 p refs
Transl. into ENGLISH of the book "Deshifirovaniye Aerofotosnimkov dlya Geomorfologicheskikh Issledovaniy" Leningrad, Leningrad Univ. Press, 1969
(Contract NASw-2038)

(NASA-TT-F-624) Avail: NTIS CSCL 08G

The application of aerial photograph interpretation in field and office geomorphological research and photointerpretation is described. Relief types and forms, their origin, and interrelationships between the latter and geological structure are described. Aerial photographs of relief forms representative of the various landscape-geographical conditions in different regions in the Soviet Union are included. Author

N72-23284 Barringer Research, Ltd., Rexdale (Ontario).
CORRELATION SPECTROMETRY APPLIED TO EARTH RESOURCES

Anthony R. Barringer In Princeton Univ. Proc. of the Princeton Univ. Conf. on Aerospace Methods for Revealing and Evaluating Earth's Resources Jun. 1970 37 p
Copyright. Avail: Issuing Activity

Spectrometry from aircraft, balloons, and satellites is discussed for detecting minerals and oils, air pollution, and earth structural features. The emphasis is on gases, and in particular air pollutants: sulfur dioxide, nitrogen dioxide, mercury, and iodine. The association of certain gases with mines and mineral deposits and with marine life is described, and aerial detection of air pollution over cities and industrial areas is also discussed. N.E.N.

N72-23291 Geological Survey, Washington, D.C. Earth Resources Observation Satellite Program.

USER NEEDS IN GEOLOGY AND CARTOGRAPHY
William A. Fischer In Princeton Univ. Proc. of the Princeton Univ. Conf. on Aerospace Methods for Revealing and Evaluating Earth's Resources Jun. 1970 24 p
Copyright. Avail: Issuing Activity

The data needs of geology and cartography, and the technological developments for acquiring and processing the data are discussed. The initial needs for acquiring data from space are defined as having the fewest possible variables, having the capability to assess change in many terms, and providing data in three specific bands. These bands are green, for seeing through water; red, for geological features and crop identification; and near infrared, for seeing water in contrast to seeing through water and seeing vigorous vegetation distribution. The uses of aerial and spaceborne photography are illustrated and the advantages of the latter in data quality and economy are described. Cartographic applications such as water distribution and soils maps are discussed, and it is felt that early applications will be more in the field of cartography than geology. The geological uses include recognition of deep-seated structures, definition of the thermal structure of the earth, and determination of the electrical composition or energy state of material from luminescence data. N.E.N.

N72-23295 United Nations, New York. Resources and Transport Div.

THE EXPLORATION OF NON-AGRICULTURAL NATURAL RESOURCES IN DEVELOPING COUNTRIES BY THE UNITED NATIONS

Joseph Barnea In Princeton Univ. Proc. of the Princeton Univ. Conf. on Aerospace Methods for Revealing and Evaluating Earth's Resources Jun. 1970 6 p refs

Copyright. Avail: Issuing Activity

The work of the Economic and Social Affairs Department of the United Nations in exploring resources of economic significance is outlined. The main thrust is in the execution of projects in developing countries. Activities are reported on exploring for

minerals (including copper and uranium), ground water, rivers and river basins, steam fields (geothermal energy), offshore petroleum, and offshore tin. N.E.N.

N72-23325*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

GEOLOGICAL FEATURES IN WYOMING FROM NIMBUS 1
Nicholas Short *In its Significant Accomplishments in Sci.*, 1970 1971 p 2-7

Avail: NTIS HC \$3.00 CSCL 08G

The identification of ground features in Nimbus photography by comparisons with geology, soils, and vegetation maps is discussed for the Wyoming-Colorado area. It is concluded that in a semiarid region, high topographic relief shows good coassociation with exposed geology and with vegetation and, to a lesser degree, with soils types. In lower, flatter basins, most tonal patterns are related to subtle variations in soil color and vegetation cover. It is thought that maps based on spectral parameters as the proper descriptor of surface features may be required. F.O.S.

N72-23371*# Geological Survey, Washington, D.C.
RECOGNITION ON SPACE PHOTOGRAPHS OF STRUCTURAL ELEMENTS OF BAJA CALIFORNIA

Warren Hamilton 1971 29 p refs Sponsored by NASA
(NASA-CR-126391; USGS-PP-718) Avail: NTIS HC \$0.45 CSCL 08G

Gemini and Apollo photographs provide illustrations of known structural features of the peninsula and some structures not recognized previously. An apparent transform relationship between strike-slip and normal faulting is illustrated by the overlapping vertical photographs of northern Baja California. The active Agua Blanca right-lateral strike-slip fault trends east-southeastward to end at the north end of the Valle San Felipe and Valle Chico. The uplands of the high Sierra San Pedro Martir are a low-relief surface deformed by young faults, monoclines, and warps, which mostly produce west-facing steps and slopes; the topography is basically structural. The Sierra Cucapas of northeasternmost Baja California and the Colorado River delta of northwesternmost Sonora are broken by northwest-trending strike-slip faults. A strike-slip fault is inferred to trend northward obliquely from near Cabo San Lucas to La Paz, thence offshore until it comes ashore again as the Bahia Concepcion strike-slip fault. Author

N72-23444# South Dakota School of Mines and Technology, Rapid City.

A PRELIMINARY INVESTIGATION OF TERRESTRIAL AND LOW ALTITUDE AERIAL INFRARED PHOTOGRAPHY AS AN AID IN DETERMINING WATER TABLE DEPTHS AND BURIED GEOLOGICAL STRUCTURES IN THE PIERRE SHALE IN WESTERN SOUTH DAKOTA Final Report

E. R. Hoskins, D. W. Hammerquist, and P. H. Rahn Jun. 1971 70 p refs Prepared in cooperation with South Dakota Dept. of Highways

(PB-206494) Avail: NTIS HC \$3.00 CSCL 08G

An investigation was carried out to identify faults and joints and water table depths in road cuts in the Pierre shale from terrestrial and low altitude aerial photographs. Over 1,200 photographs were taken during the study. Three sites on the Interstate 90 east of Rapid City received repeated monthly multispectral photographic coverage for about one year. Black and white panchromatic, natural color, and infrared color films were used. The negatives and transparencies were then enlarged and printed onto both color and black and white paper with various filters on the enlarger to attempt to enhance the data presentation. Author (GRA)

N72-23451# Delaware Univ., Newark. Coll. of Marine Studies.
A GUIDE TO THE GEOLOGY OF DELAWARE'S COASTAL ENVIRONMENTS

John C. Kraft Oct. 1971 224 p refs Presented at Geol. Soc. of Am. Ann. Meeting and Field Trip, 30 Oct. - 3 Nov. 1971

(Contract N00014-69-A-0407)

(AD-736036; CMS-2GL039; TR-1) Avail: NTIS CSCL 08/7

The low-lying Delaware coast includes the highly varied geomorphic elements of a major estuary: highlands undergoing erosion; spits; dunes, marshes; and a lagoon-barrier shoreline. Vertical sediment sequences and geomorphic patterns as interpreted in this study should form useful models in deciphering paleogeography and sedimentary processes of coastal change. The three major elements of coastal change identified include: (1) the relative rise in sea level (now proceeding at a rate of approximately 1/2 foot per century), (2) coastal erosion and deposition processes, and (3) the resultant sequences of sedimentary lithosomes which reveal the past history of coastal change. The physical elements of the coastal geology are illustrated with photographs comparing details on the surface and from the air. Many diagrams and cross sections interpret and project and structural information obtained in field surveys.

Author (GRA)

N72-24454# Rice Univ., Houston, Tex. Dept. of Geology.
DEVELOPMENT OF REMOTE METHODS FOR OBTAINING SOIL INFORMATION AND LOCATION OF CONSTRUCTION MATERIALS USING GAMMA RAY SIGNATURES
Semiannual Report

J. A. S. Adams, H. C. Clark, R. B. Clark, J. S. Duval, T. F. Schwarzer, and J. M. Worden 31 Dec. 1971 182 p refs

(Contract DACA39-69-C-0048; Proj. Themis)

(AD-737717) Avail: NTIS CSCL 08/7

Contents: Experimental comparison of NaI(Tl) and solid organic scintillation detectors for use in remote sensing of terrestrial gamma rays; Hydrologic investigations and the significance of U-234/U-238 disequilibrium in the ground waters of central Texas; Radon emanation investigations; Computer simulation and a simple approach to some topographical considerations; The discrimination of rock and soil types via low altitude airborne gamma-ray spectrometry in Payne County, Oklahoma.

GRA

N72-24880# Joint Publications Research Service, Arlington, Va.
TERRESTRIAL GEOPHYSICS c13

In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 275 9 May 1972 p 41-56

Avail: NTIS HC \$6.75

Studies of geophysics are briefly reported, with the emphasis on earthquake investigations, crustal structure and thickness determinations, and geomagnetism. Geothermal activity surveys, magnetotelluric sounding data, oil and gas resources, gravimetry, and data processing techniques are also mentioned. N.E.N.

N72-26334 Idaho Univ., Moscow.

THIRTY-FIVE MILLIMETER COLOR OBLIQUE AERIAL PHOTOGRAPHY AS A TOOL FOR RECONNAISSANCE EXPLORATION FOR URANIUM MINERALIZATION IN THE TERTIARY BASINS OF WYOMING Ph.D. Thesis

Stanley Cameron Grant 1971 236 p

Avail: Univ. Microfilms Order No. 72-2083

An evaluation of techniques, films, and procedures for 35mm color aerial photography in uranium mineral exploration is presented. The Tertiary rocks of the Clarkson Hill-Rattlesnake Range area, 22 miles southwest of Casper, Wyoming, were studied. The Munsell Color System was selected to identify the color in soils and rocks. Soil and rock samples were analyzed by qualitative emission spectroscopy to determine possible controls for color. Interpretation of analyses supports findings of others that colors result from oxides of iron in varying quantities. The geology of the primary area was studied to provide an accurate ground basis for aerial photography and to determine locations favorable for uranium mineralization. Tertiary formations and structure were mapped. Dissert. Abstr.

N72-27348# Intermountain Field Operation Center, Denver, Colo.

SATELLITE MONITORING OF OPEN PIT MINING OPERATIONS

04 GEOLOGY AND MINERAL RESOURCES

William C. Henkes 1971 31 p
(BM-IC-8530) Avail: SOD \$0.35

Anticipating the availability of space altitude imagery from the earth resource technology satellites, the Bureau of Mines investigated the possibilities of using such imagery in its activities in solid waste disposal, reclamation of mine workings, and mineral resource inventory. The study indicates that monitoring open pit and strip mining operations can be done using conventional techniques if the sharpness of the imagery is sufficiently high. Possibilities also exist for semiautomated processes for change detection. Author

N72-27353*# Geological Survey, Washington, D.C. TEST OF AIRBORNE FLUOROMETER OVER LAND SURFACES AND GEOLOGIC MATERIALS

George E. Stoertz and William R. Hemphill May 1970 45 p
refs

(NASA Order T-80485C)

(NASA-CR-127529; USGS-IR-NASA-185) Avail: NTIS HC
\$4.25 CSCL 08G

Response of an experimental Fraunhofer line discriminator to a wide range of surficial deposits common in deserts and semideserts was tested in the laboratory and from an H-19 helicopter. No signals attributable to fluorescence were recorded during 540 miles of aerial traverses over southeastern California and west-central Arizona. It was concluded that exposed surfaces of target materials throughout the traverses were either nonluminescent at 5890 Å or not sufficiently so to be detectable. It cannot be ruled out that the lack of fluorescence is partly attributable to surficial coatings of nonluminescent weathered material. The principal route surveyed from the air was from Needles, California to Furnace Creek Ranch, Death Valley and return, via the Amargosa River valley, Silurian Lake (dry), Silver Lake (dry), and Soda Lake (dry). Principal targets traversed were unconsolidated clastic sediments ranging from silty clay to cobbles, and a wide range of evaporite deposits. Author

N72-28320*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

APPLICATION OF ERTS AND EREP IMAGES TO GEOLOGIC INVESTIGATIONS OF THE BASIN AND RANGE COLORADO PLATEAU BOUNDARY IN NORTHWESTERN AND NORTH-CENTRAL ARIZONA, NO. 308 Progress Report, 15 Jun. - 15 Aug. 1972

Alexander F. H. Goetz, principal investigator 15 Aug. 1972
2 p Sponsored by NASA

(E72-10014; NASA-CR-127704; GSFC-ID-PR522) Avail: NTIS
HC \$3.00 CSCL 08G

This report contains no significant results.

Author

N72-28365# Bureau of Mineral Resources, Geology and
Geophysics, Canberra (Australia).

LAVERTON-EDJUDINA AIRBORNE MAGNETIC AND RADIOMETRIC SURVEY, WESTERN AUSTRALIA 1969

D. B. Tipper and R. M. Gerdes 1971 112 p refs

(Bull-118) Avail: NTIS HC \$7.75

An airborne magnetic and radiometric survey of the Laverton and Edjudina 1:250,000 map areas was flown in 1966 to assist the systematic regional geological mapping of the Western Australia Precambrian Shield, and the search for metals. The magnetic pattern is attributed to differences in magnetic properties between rock units at or near ground level. Geological strikes and the boundaries of major rock units were interpreted by delineating magnetic trends, by subdividing the area into zones of specified magnetic character, and by assessing the geological significance of these zones by reference to mapped geology. The area comprises heterogeneous acidic igneous masses, with ill-defined more basic regions, which enclose elongated outcrops of interbedded lava and sediment sequences. Areas where geological and magnetic evidence conflict are discussed in some detail. Sixteen fold axes, one cross-fold axis, twelve major dikes (one remanently magnetized), and fourteen faults were delineated. Ultrabasic intrusions could not be resolved with absolute certainty from the magnetic pattern. The radiometric data reveal many

high anomalies which are mainly correlated with granite outcrops. Eighty-three radiometric anomalies satisfying the point-source criteria were detected and, of these, fifty-one are recommended for ground investigation. Author

N72-28366*# Michigan Univ., Ann Arbor. Willow Run Labs. THE NASA EARTH RESOURCES SPECTRAL INFORMATION SYSTEM: A DATA COMPILATION

Virginia Leeman, Dianne Earing, Robert K. Vincent, and Sharon
Ladd May 1971 574 p refs

(Contract NAS9-9784)

(NASA-CR-115757; WRL-31650-24-T) Avail: NTIS HC \$30.75
CSCL 08G

The NASA Earth Resources Spectral Information System and the information contained therein are described. It contains an ordered, indexed compilation of natural targets in the optical region from 0.3 to 45.0 microns. The data compilation includes approximately 100 rock and mineral, 2600 vegetation, 1000 soil, and 60 water spectral reflectance, transmittance, and emittance curves. Most of the data have been categorized by subject, and the curves in those subject areas have been plotted on a single graph. Those categories with too few curves and miscellaneous categories have been plotted as single-curve graphs. Each graph, composite of single, is fully titled to indicate curve source and is indexed by subject to facilitate user retrieval. Author

N72-28390 Bureau de Recherches Geologique et Minieres,
Paris (France). Service Photogeologie.

POSSIBILITIES OF APPLYING NEW REMOTE SENSING TECHNIQUES TO GEOLOGY AND HYDROLOGY (POS- SIBILITES D'UTILISATION DES TECHNIQUES NOUVELLES DE LA TELEDETECTION EN GEOLOGIE ET EN HYDRO- GEOLOGIE)

J.-Y. Scanvic and G. Weecksteen /In CNES Remote Sensing of
Earth Resources Oct. 1971 p 189-217 In FRENCH Original
contains color illustrations

Results obtained from remote sensing techniques applied to terrain analysis of Pays de Bray, Beauce, Val de Loire, La Ciotat, and Minervois de l'Herault are presented. They include results from aerial photographs using different photographic emulsions, and from infrared scanning. The hydrological and geological data are analyzed, and both techniques are compared. ESRO

N72-28391 Paris Univ., Orsay (France). Lab. of Petrology-
Volcanology.

CONTRIBUTION OF AIRBORNE INFRARED SENSING TO THE STUDY OF ERUPTIVE TERRAINS (CHAINE DES PUYS, BANNE D'ORDANCHE, AGDE) [CONTRIBUTION DE LA DETECTION AEROPORTEE DANS L'INFRAROUGE A L'ETUDE DE TERRAINS ERUPTIFS (CHAINE DES PUYS, BANNE D'ORDANCHE, AGDE)]

S. Paul /In CNES Remote Sensing of Earth Resources Oct.
1971 p 218-245 In FRENCH

Results from infrared photographs taken during an earth resources technology aircraft survey of the nonactive volcanic terrains of Chaîne des Puys, Banne d'Ordanche, and Adge (France) are presented and discussed. The flights were made during summer 1970, winter 1971, and spring 1971. The photointerpretation revealed a thermal anomaly at the Aydat Lake surface. It is concluded that a very high resolution scanning can be obtained by airborne detection of far infrared radiation emission in volcanic regions. ESRO

N72-28401# Geological Survey, Washington, D.C.

THE APPLICATION OF GEOCHEMICAL, BOTANICAL, GEOPHYSICAL, AND REMOTE SENSING MINERAL PROSPECTING TECHNIQUES TO TROPICAL AREAS STATE OF THE ART AND NEEDED RESEARCH

John Van N. Dorr, II, Donald B. Hoover, Terry W. Offield, and

Hansford T. Shacklette Dec. 1971 103 p refs
(Grant PASA-TA-(IC)-9-72)

(PB-207191) Avail: NTIS HC \$3.00 CSCL 08G

A preliminary study is presented on the development of geophysical, geochemical, and geobotanical mineral prospecting techniques for application in tropical areas, both humid and arid. Each technique is discussed as to the state of the art, instrument and survey costs, research gaps and priorities. An analysis is made of the developing countries' capability to use the results of successful research and likely economic payoff. Author (GRA)

N72-29272* New York State Univ., Albany.

TO EVALUATE ERTS-A DATA FOR USEFULNESS AS GEOLOGICAL SENSOR Progress Report, period ending 31 Jul. 1972

Y. W. Isachsen, Principal Investigator 31 Jul. 1972 2 p
Sponsored by NASA

(E72-10020; NASA-CR-127744) Avail: NTIS HC \$3.00 CSCL 08G

There are no author-identified significant results in this report.

N72-29305* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

RADIOMETRIC IMAGES ON IR RESTSTRAHLEN EMISSION FROM ROCK SURFACES c23

Warren A. Hovis /In its 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 13 p ref Original contains color illustrations

CSCL 08G

In order to test the feasibility of remote sensing of the reststrahlen effect, a two-channel radiometer was constructed that sensed radiance in two channels simultaneously. The channels selected were 8.3 to 9.3 and 10.2 to 11.2 micrometers. The instrument had an instantaneous geometric field of view of 2 deg x 2 deg and a rotating mirror scan mechanism designed to produce contiguous scans from a DC-3 aircraft at approximately 10,000 ft. altitude. Signals were recorded on a magnetic tape recorder and subsequently converted to equivalent black body temperature for both channels. Results of measurements made over a number of rock types in the Maryland-Pennsylvania region are briefly discussed. A.L.

N72-29333* Michigan Univ., Ann Arbor. Willow Run Labs.
EXPERIMENTAL METHODS FOR GEOLOGICAL REMOTE SENSING

Robert K. Vincent /In NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 12 p refs Original contains color illustrations

CSCL 08G

During the past year a two channel IR technique for discrimination among silicate rocks was tested for a second time, a three channel IR method was tested for the first time, and a new visible-reflective IR ratio method was hypothesized and qualitatively tested for iron oxide recognition. Both the two channel and three channel IR ratios methods were capable of discriminating felsic from mafic rock types. The three-channel ratio values measured by the scanner were found to agree, within reasonable limits, with the values of R calculated from laboratory data. The capability of the three channel method to obtain absolute ratios is accompanied by a costly processing routine. The two channel technique is superior for low thermal contrast scenes about which some ground truth is available because of its speed and economy. Author

N72-29336* Kansas Univ./Center for Research, Inc., Lawrence. Remote Sensing Lab.

SPACE CONFIGURATION AS AN EXPLANATION FOR LITHOLOGY-RELATED CROSS-POLARIZED RADAR IMAGE ANOMALIES c07

James R. McCauley /In NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 9 p refs

(Contract NAS9-10261)

CSCL 171

Three rock types are described that produce dark cross-polarized images on Ka-band imagery: lava flows dating from Pleistocene and Holocene, some Tertiary volcanics, and certain massive sandstones. Their planar surfaces are large with respect to the wavelength of the Ka-band system, yet are small in comparison to the resolution. It is found that only outcrops with proper faceted surface orientations produce significant radar returns showing the dominance of specular reflectors. The omnidirectional attitude of the facets and their wide distribution on the outcrops explains the independence of look-direction that the flat-lying anomalous outcrops exhibit in production of darker cross-polarized images. G.G.

N72-29343* Colorado School of Mines, Golden. Geology Dept.

BONANZA PROJECT, 1971 c08

Keenan Lee /In NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 23 p

CSCL 09C

Research on the application of remote sensing techniques to the mineral industry stresses photointerpretation by human interpreter experienced in the extraction of geological information from aerial color and multiband photographs and from thermal scanner imagery. Also considered are optical and digital image enhancement, multiband color additive projection, video image processing, and computer reduction and analysis of infrared spectrometry. Evaluation of those parameters which have the most contrast between adjacent rock formations and which can be remotely sensed establish the following most useful geological characteristics: Topographic landform, color, albedo, and surface temperature. G.G.

N72-29353* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MICROWAVE PROPERTIES OF GEOLOGICAL MATERIALS: STUDIES OF PENETRATION DEPTH AND MOISTURE EFFECTS

John C. Blinn, III and Jack C. Quade (Nevada Univ., Reno) /In NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 12 p refs

CSCL 08G

Summarized are the results of two of a series of controlled experiments performed during the summer of 1970. The first series of experiments to determine penetration depth showed the value of having a modeled response and data reduced in real time for examination in the field. The results suggest a radiometric method for measuring the microwave properties of materials in bulk and are applicable to studies of sea ice and other naturally layered media. The sensitivity of the microwave emission to changes in moisture content has inspired a number of airborne and ground based investigations. Although the effect is dominant under certain conditions, the complicating factors of soil type, roughness, vegetation, etc. seem to govern the conclusions regarding its application at this time. Author

N72-29355* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

FOURTH ANNUAL EARTH RESOURCES PROGRAM REVIEW. VOLUME 3: US GEOLOGICAL SURVEY PROGRAMS

21 Jan. 1972 309 p refs Rev. held at Houston, Tex., 17-21 Jan. 1972 Original contains color illustrations

(NASA-TM-X-68398; MSC-05937-Vol-3) Avail: NTIS HC \$17.50 CSCL 08G

A review of various aspects of the Earth Resources Program is presented. Particular attention was given to the results of analysis of data obtained with Manned Spacecraft Center and other aircraft which have contributed to the program. Data cover geology, geography, hydrology, agriculture, forestry, and oceanography.

N72-29356* Geological Survey, Menlo Park, Calif.

SATELLITE RELAY TELEMETRY IN THE SURVEILLANCE OF ACTIVE VOLCANOES AND MAJOR FAULT ZONES

04 GEOLOGY AND MINERAL RESOURCES

Jerry P. Eaton and Peter L. Ward /In NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 17 p refs

CSCSL 09F

A review was made of efforts to develop a dense telemetered microearthquake network to study earthquake mechanics along the San Andreas fault and the strain mechanics of the Kilauea Volcano. The principle elements and objectives of the ERTS-A proposal are outlined. Some of the aspects of the earthquake network and the results obtained from it as well as some promising experiments in computerized record processing are discussed. Author

N72-29357* Geological Survey, Denver, Colo. GEOLOGICAL MATERIAL DISCRIMINATION FROM NIMBUS SATELLITE DATA

H. A. Pohn, T. W. Offield, and Kenneth Watson /In NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 15 p refs Original contains color illustrations

CSCSL 08G

An analysis was made of Nimbus satellite data to determine its suitability in determining the physical properties of surface materials. Attempts were also made to use these data in developing analytical techniques for handling data from other earth resources and meteorological satellites. Author

N72-29358* Geological Survey, Denver, Colo. NEAR INFRARED IRON ABSORPTION BANDS: APPLICATIONS TO GEOLOGIC MAPPING AND MINERAL EXPLORATION

Lawrence C. Rowan /In NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 18 p refs Original contains color illustrations

CSCSL 08G

A spectroscopic analysis of the difference in reflectance of iron-rich and iron-poor minerals was made. Attempts were made to use these minima contrast in geological mapping and metallic mineral exploration of large areas from near infrared and visible satellite images. Data cover pertinent laboratory spectroscopic investigations, applications of spectral differences to the discrimination of two important metamorphic rock types, and mineral exploration by aircraft in Beartooth Mountains, Montana. Author

N72-30304*# Colorado School of Mines, Golden. GEOLOGIC AND MINERAL AND WATER RESOURCES INVESTIGATIONS IN WESTERN COLORADO Report for 30 Jun. - 31 Aug. 1972

Robert G. Reeves, Principal Investigator 7 Sep. 1972 3 p refs (Contract NAS5-21778) (E72-10024; NASA-CR-127780) Avail: NTIS HC \$3.00 CSCSL 08G

There are no author-identified significant results in this report.

N72-30309*# North American Rockwell Corp., Thousand Oaks, Calif. IDENTIFICATION AND INTERPRETATION OF TECTONIC FEATURES FROM ERTS-A IMAGERY Progress Report, 30 May - 31 Jul. 1972

Monem Abdel-Gawad, Principal Investigator 31 Jul. 1972 1 p (Contract NAS5-21787) (E72-10029; NASA-CR-127894; SC891.1PR) Avail: NTIS HC \$3.00 CSCSL 08G

There are no author-identified significant results in this report.

N72-30384# Colorado School of Mines, Golden. RECOMMENDATIONS OF THE WORKING GROUP ON ELECTROMAGNETIC METHODS

George V. Keller 6 Mar. 1972 23 p (Contract N00014-71-A-0430-0002)

(AD-740122) Avail: NTIS CSCSL 08/7

The report discusses the problem of measuring the minimum electrical conductivity in the earth's crust, with special reference to the possibility of longrange communications through such a low-conductivity region. GRA

N72-31331*# Geological Survey, Washington, D.C. GEOLOGICAL QUESTIONS AND SIGNIFICANT RESULTS PROVIDED BY EARLY ERTS-1 DATA

William D. Carter 22 Sep. 1972 11 p Presented as Preliminary Findings from Analyses of ERTS Observations, NASA Goddard Space Flight Center, Greenbelt, Md., 29 Sep. 1972 Sponsored by NASA (E72-10040; NASA-CR-128121) Avail: NTIS HC \$3.00 CSCSL 08G

There are no author-identified significant results in this report. The organization for evaluating the uses of Earth Resources Technology Satellite data of the United States and foreign areas is described. The implementation of a system to disseminate the data to the geographical areas of interest is discussed. Brief descriptions are included of data received for the following areas: (1) east coast, (2) central United States, (3) western mountain areas, (4) west coast areas, and (5) Alaska. It is concluded that the multiband approach is useful with each of the bands providing unique and useful information. The difficulties in handling the data if all seven bands are used are examined. P.N.F.

N72-31332*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md. A FIRST LOOK AT GEOLOGICAL ASPECTS OF ERTS IMAGERY OF WYOMING

N. Short 29 Sep. 1972 2 p Presented as Preliminary Findings from Analyses of ERTS Observations, NASA Goddard Space Flight Center, Greenbelt, Md., 29 Sep. 1972 (E72-10041; NASA-TM-X-68776) Avail: NTIS HC \$3.00 CSCSL 08G

There are no author-identified significant results in this report. The analysis of six MSS-5 frames covering most of the western half of Wyoming is discussed. The frames under consideration covered the following areas: (1) Rock Springs, (2) Western Wind River Basin, and (3) Bighorn Basin-Absarokas Mountains. Miscellaneous observations concerning identification of natural and man-made structures are included. P.N.F.

N72-31339*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md. PRELIMINARY GEOLOGIC EVALUATION OF ERTS IMAGERY

Paul D. Lowman, Jr. 29 Sep. 1972 3 p Presented as Preliminary Findings from Analyses of ERTS Observations, NASA Goddard Space Flight Center, Greenbelt, Md., 29 Sep. 1972 Original contains color illustrations. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 (E72-10048; NASA-TM-X-68806) Avail: NTIS HC \$3.00 CSCSL 08G

There are no author-identified significant results in this report.

N72-31354*# Argus Exploration Co., Los Angeles, Calif. A RECONNAISSANCE SPACE SENSING INVESTIGATION OF CRUSTAL STRUCTURE FOR A STRIP FROM THE EASTERN SIERRA NEVADA TO THE COLORADO PLATEAU Progress Report, 15 Jun. - 31 Aug. 1972 Ira C. Bechtold, Principal Investigator 8 Sep. 1972 5 p (Contract NAS5-21809) (E72-10071; NASA-CR-128086) Avail: NTIS HC \$3.00 CSCSL 08G

There are no author-identified significant results in this report.

N72-31355*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

MAPPING OF THE MAJOR STRUCTURES OF THE AFRICAN RIFT SYSTEM Progress Report, 1 Jul. - 31 Aug. 1972

Paul Mohr, Principal Investigator 31 Aug. 1972 1 p

(Contract NAS5-21747)

(E72-10072; NASA-CR-128087) Avail: NTIS HC \$3.00 CSCL 08E

There are no author-identified significant results in this report.

N72-31365*# Environmental Research Inst. of Michigan, Ann Arbor.

AN ERTS MULTISPECTRAL SCANNER EXPERIMENT FOR MAPPING IRON COMPOUNDS

Robert K. Vincent, Principal Investigator [1972] 1 p Sponsored by NASA

(E72-10085; NASA-CR-128100; Rept-O11229-5-S) Avail: NTIS HC \$3.00 CSCL 08G

There are no author-identified significant results in this report.

N72-31369*# Colorado School of Mines, Golden. Dept. of Geology.

APPLICATIONS OF REMOTE SENSOR DATA TO GEOLOGIC AND ECONOMIC ANALYSIS ON THE BONANZA TEST SITE, COLORADO Semiannual Progress Report, 1 Oct. - 31 Mar. 1972

Robert G. Reeves, comp. May 1972 121 p refs Prepared in cooperation with Martin Marietta Corp., Denver, Colo.

N72-31450# Barringer Research Ltd., Rexdale (Ontario). **RADIOPHASE: A NEW SYSTEM OF CONDUCTIVITY MAPPING**

A. R. Barringer and J. D. McNeill [1968] 11 p refs Avail: NTIS HC \$3.00

A new system, called Radiophase, utilizes the signals from VLF radio stations to detect the presence of dipping conductive sheets in the ground, and to estimate the surface impedance of a homogeneous or horizontally stratified earth. The technique measures those components of the VLF horizontal magnetic and electric fields which are in phase quadrature with the vertical electric field. Both theoretical studies and modelling have demonstrated that these quadrature components are greatly influenced by the impedance of the underlying terrain. An airborne version of the system was flown on surveys over known mineral occurrences. Preliminary results suggest interesting correlation between the Radiophase signals and the underlying geology. Other potential applications include the airborne mapping of water conductivity to determine the extent of pollution and estuarine salinity, and airborne mapping of ground conductivity to locate faults, shear zones, the distribution of permafrost, aquifers, etc. Author

N72-32333*# Geological Survey, Menlo Park, Calif. **REMOTE SENSING OF PERMAFROST AND GEOLOGIC HAZARDS IN ALASKA** Progress Report, 1 Jul. - 31 Aug. 1972

Oscar J. Ferrians, Jr., Principal Investigator 1 Sep. 1972 7 p Sponsored by NASA

(E72-10080; NASA-CR-128134) Avail: NTIS HC \$3.00 CSCL 08L

There are no author-identified significant results in this report.

N72-32334*# Geological Survey, Washington, D.C. **THERMAL SURVEILLANCE OF VOLCANOES** Progress Report, 1 Jul. - 31 Aug. 1972

Jules D. Friedman, Principal Investigator 1 Sep. 1972 7 p Sponsored by NASA

(E72-10061; NASA-CR-128135) Avail: NTIS HC \$3.00 CSCL 08E

The author has identified the following significant results. A systematic aircraft program to monitor changes in the thermal emission from volcanoes of the Cascade Range has been initiated and is being carried out in conjunction with ERTS-1 thermal surveillance experiments. Night overflights by aircraft equipped with thermal infrared scanners sensitive to terrestrial emission in the 4-5.5 and 8-14 micron bands are currently being carried out at intervals of a few months. Preliminary results confirm that Mount Rainier, Mount Baker, Mount Saint Helens, Mount Shasta, and the Lassen area continue to be thermally active, although with the exception of Lassen which erupted between 1914 and 1917, and Mount Saint Helens which had a series of eruptions between 1831 and 1834, there has been no recent eruptive activity. Excellent quality infrared images recorded over Mount Rainier, as recently as April, 1972, show similar thermal patterns to those reported in 1964-1966. Infrared images of Mount Baker recorded in November 1970 and again in April 1972 revealed a distinct array of anomalies 1000 feet below the crater rim and associated with fumaroles or structures permitting convective heat transfer to the surface.

N72-32336*# Earth Satellite Corp., Washington, D.C. **STUDY OF APPLICATION OF ERTS-1 IMAGERY TO FRACTURE-RELATED MINE SAFETY HAZARDS IN THE COAL MINING INDUSTRY** Progress Report, 1 Jul. - 1 Sep. 1972

Charles Wier, Principal Investigator (Indiana Geol. Surv., Bloomington), Frank J. Wobber, Principal Investigator, Orville R. Russell, and Roger Amato 1 Sep. 1972 3 p Sponsored by NASA

(E72-10064; NASA-CR-128080) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. Numerous fractures are identifiable on the 1:120,000 color infrared photography. Some of these fractures are in the proximity of operating open pit mines and should provide opportunities for field checking and confirmation.

N72-32338*# Stanford Univ., Calif. School of Earth Sciences. **STRUCTURAL AND LITHOLOGIC STUDY OF NORTHERN COAST RANGE AND SACRAMENTO VALLEY, CALIFORNIA** Progress Report

Ernest I. Rich, Principal Investigator [1972] 2 p Sponsored by NASA

(E72-10074; NASA-CR-128089) Avail: NTIS HC \$3.00 CSCL 08G

There are no author-identified significant results in this report.

N72-32339*# Wyoming Univ., Laramie. Dept. of Geology. **ANALYSIS OF ERTS-1 IMAGERY OF WYOMING AND ITS APPLICATION TO EVALUATION OF WYOMING'S NATURAL RESOURCES** Progress Report, Jul. - Aug. 1972

Robert S. Houston, Principal Investigator and Ronald W. Marrs Sep. 1972 11 p

(Contract NAS5-21799)

(E72-10079; NASA-CR-128094) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. The major effort has been toward interpretation of the intermediate and high altitude aircraft data which was available. Project investigators were able to delineate various structures and lithologic units in well-exposed sedimentary sequences and in regions of Precambrian igneous and metamorphic rocks. In one area, the Precambrian lithologies, which were previously unmapped, include a taconite formation which might be economically important.

N72-32348*# Geological Survey, Menlo Park, Calif. **IDENTIFICATION OF GEOSTRUCTURES OF CONTINENTAL CRUST, PARTICULARLY AS THEY RELATE TO MINERAL-RESOURCE EVALUATION** Progress Report, 1 Jul. 31 Aug. 1972

George Gryc, Principal Investigator and Ernest H. Lathram 1 Sep. 1972 4 p Sponsored by NASA

04 GEOLOGY AND MINERAL RESOURCES

(E72-10095; NASA-CR-128144) Avail: NTIS HC \$3.00 CSCL 08G

The authors have identified the following significant results. As a precursor to the ERTS-1 investigation, the spatial relationship of geosstructures seen on Nimbus IDCs photographs to the distribution of mineralized areas in Alaska and western Canada was analyzed to determine the possible metallogenic significance of the geosstructures. In Canada, mercury and porphyry molybdenum deposits are closely associated with strong northwest-trending fault systems: the development of mineralized regions seems related to major crustal zones or fractures trending southwestward across the Cordillera from the Precambrian shield. In Alaska, comparison of the northeast- and northwest-trending set of possible crustal structures shown on the Nimbus photo, with the distribution of known mineral deposits suggests a similar relationship. The mineralized region of massive sulfides in Prince William Sound and upper Copper River areas and of porphyry coppers in the Nabesna area forms a broad northeast-trending belt possibly related to the Minto Arch on the Shield. The belt of metalliferous deposits in the western Alaska Range follows a comparable northeast trend. Mercury deposits, suggested by many to be fault-controlled, together with most tin and tungsten deposits, occupy a northeast-trending belt between the Bristol Bay-Mackenzie Bay linear and extensions of a linear along the lower Yukon River. This belt intersects the northwest-trending Canadian belt of similar deposits in the Fairbanks area.

N72-32350*# Geological Survey, Corpus Christi, Tex.
MONITORING CHANGING GEOLOGIC FEATURES ALONG THE TEXAS GULF COAST Progress Report, 1 Jul. - 31 Aug. 1972

Ralph E. Hunter, Principal Investigator 1 Sep. 1972 3 p
Sponsored by NASA
(E72-10097; NASA-CR-128146) Avail: NTIS HC \$3.00 CSCL 08H

There are no author-identified significant results in this report.

N72-32363*# Geological Survey, Washington, D.C.
IRON ABSORPTION BAND ANALYSIS FOR THE DISCRIMINATION OF IRON RICH ZONES Progress Report, Aug. 1972

Lawrence C. Rowan, Principal Investigator 8 Sep. 1972 2 p
Sponsored by NASA
(E72-10111; NASA-CR-128160) Avail: NTIS HC \$3.00 CSCL 08G

There are no author-identified significant results in this report.

N72-32377*# Alaska Univ., College.
GLACIOLOGICAL AND VOLCANOLOGICAL STUDIES ON THE WRANGELL MOUNTAINS, ALASKA Bimonthly Progress Report

Carl S. Benson, Principal Investigator 30 Sep. 1972 2 p
Sponsored by NASA
(E72-10129; NASA-CR-128183; BMPR-1) Avail: NTIS HC \$3.00 CSCL 08G

There are no author-identified significant results in this report.

N72-32378*# Alaska Univ., College.
EVALUATION OF FEASIBILITY OF MAPPING SEISMICALLY ACTIVE FAULTS IN ALASKA Bimonthly Progress Report
Larry Gedney, Principal Investigator 5 Oct. 1972 2 p Sponsored by NASA
(E72-10130; NASA-CR-128184; BMPR-1) Avail: NTIS HC \$3.00 CSCL 08K

There are no author-identified significant results in this report.

N72-32388*# Montana Univ., Missoula. Dept. of Geology.
APPLICABILITY OF ERTS-A TO MONTANA GEOLOGY Progress Report, period ending 30 Sep. 1972

Robert M. Weidman, Principal Investigator 9 Oct. 1972 7 p
(Contract NAS5-21826)

(E72-10141; NASA-CR-128210) Avail: NTIS HC \$3.00 CSCL 08G

There are no author-identified significant results in this report.

N72-32399*# Scientific Translation Service, Santa Barbara, Calif.

WHAT GRAVITY TELLS US

Kurt Lambeck and Francois Barlier Washington NASA Sep. 1972 25 p refs Transl. into ENGLISH from Sci. Progr. Decouverte (France), Nov. 1971 p 24-33
(Contract NASw-2035)

(NASA-TT-F-14546) Avail: NTIS HC \$3.25 CSCL 08N

The use of satellites to determine magnetic anomalies in the structure of the earth and the application to measuring the gravitational field are discussed. The causes of anomalies are related to the accepted structure of the earth and the viscosity of the earth mantle. The correlation between the distribution of gravity anomalies and the tectonic features of the earth is examined. The benefits derived by other sciences from satellite observations are described.

P.N.F.

N72-32489*# Geological Survey, Denver, Colo.

A STUDY OF QUATERNARY LANDFORMS AND MATERIALS IN THE MIDWEST AND GREAT PLAINS Progress Report, 1 Jul. - 31 Aug. 1972

Roger B. Morrison, Principal Investigator and George R. Hallberg 1 Sep. 1972 3 p Sponsored by NASA
(E72-10105; NASA-CR-128154) Avail: NTIS HC \$3.00 CSCL 08G

There are no author-identified significant results in this report.

N72-33302*# North American Rockwell Corp., Thousand Oaks, Calif. Science Center.

IDENTIFICATION AND INTERPRETATION OF TECTONIC FEATURES FROM ERTS-1 IMAGERY Progress Report, 31 Jul. - 30 Sep. 1972

Monem Abdel-Gawad, Principal Investigator, Oct. 1972 6 p
(Contract NAS5-21767)
(E72-10143; NASA-CR-127328) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. An important fault zone, which is strongly suspected of being seismically active, was identified on RBV images, ERTS E-1013-17305 (101, 201, and 301), in northeastern Utah. This fault zone is not shown on the Geological Map of the United States nor on the Tectonic Map of North America. When the epicenters of historic earthquakes and their magnitudes were plotted on an overlay corresponding to the scene, a major earthquake cluster up to magnitude 4.9 was found through which the fault zone passes. This suspected active fault zone runs in a northwest-southeast direction cutting across the Patmos Mountains and the southwestern side of the East Tavaputs Plateau from near the junction of the Colorado River with the Dolores River to and beyond the town of Dragerton, Utah. The fault zone which will subsequently be referred to as the Dragerton fault zone appears to be an element of a major tectonic lineament which includes the Moab fault, Salt Valley, Spanish and Lisbon Valleys. Because of the limited imagery coverage received so far, the extent of this lineament or its tectonic significance cannot be ascertained. It is suspected, however, that it constitutes a major crustal break in the Colorado Plateau.

N72-33313*# National Center for Earthquake Research, Menlo Park, Calif.

INVESTIGATION OF PROTOTYPE VOLCANO SURVEILLANCE NETWORK Progress Report, 1 Jul. - 31 Aug. 1972

Jerry P. Eaton, Principal Investigator and Peter L. Ward 1 Sep. 1972 2 p Sponsored by NASA
(E72-10155; NASA-CR-128291) Avail: NTIS HC \$3.00 CSCL 08G

There are no author-identified significant results in this report.

N72-33782* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MINERAL EXPLORATION FROM HIGH ALTITUDE IMAGERY

Herbert W. Blodget *In its Significant Accomplishments in Sci.*, 1971 Jun. 1972 p 7-12 ref

CSCL 08G

N73-10347*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
APPLICATION OF ERTS AND EREP IMAGES TO GEOLOGICAL INVESTIGATIONS OF THE BASIN AND RANGE: COLORADO PLATEAU BOUNDARY IN NORTHWESTERN AND NORTH-CENTRAL ARIZONA Progress Report, 15 Aug. - 15 Oct. 1972

A. F. H. Goetz, Principal Investigator 15 Oct. 1972 5 p
Sponsored by NASA
(E72-10157; NASA-CR-128293) Avail: NTIS HC \$3.00 CSCL 08G

N73-10359*# Texas Instruments, Inc., Dallas.
EVALUATION OF COMMERCIAL UTILITY OF ERTS-A IMAGERY IN STRUCTURAL RECONNAISSANCE FOR MINERALS AND PETROLEUM Progress Report, 29 Aug. - 31 Oct. 1972

Donald F. Saunders, Principal Investigator 7 Nov. 1972 5 p
Sponsored by NASA
(E72-10180; NASA-CR-128327) Avail: NTIS HC \$3.00 CSCL 08G

N73-10360*# Michigan Univ., Ann Arbor. Willow Run Labs.
AN ERTS MULTISPECTRAL SCANNER EXPERIMENT FOR MAPPING IRON COMPOUNDS

Robert K. Vincent, Principal Investigator 6 Nov. 1972 11 p
refs Presented at 8th Symp. on Remote Sensing of Environment
Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
(Contracts NAS5-21783; NAS9-9784; BM-HO-220064)
(E72-10181; NASA-CR-128330; Rept-011676-1-S-SA) Avail: NTIS HC \$3.00 CSCL 08I

There are no author-identified significant results in this report. An experimental plan for enhancing spectral features related to the chemical composition of geological targets in ERTS multispectral scanner data is described. The experiment is designed to produce visible-reflective infrared ratio images from ERTS-1 data. Iron compounds are promising remote sensing targets because they display prominent spectral features in the visible-reflective infrared wavelength region and are geologically significant. The region selected for this ERTS experiment is the southern end of the Wind River Range in Wyoming. If this method proves successful it should prove useful for regional geologic mapping, mineralogical exploration, and soil mapping. It may also be helpful to ERTS users in scientific disciplines other than geology, especially to those concerned with targets composed of mixtures of live vegetation and soil or rock. A.L.

N73-10372*# Indiana Geological Survey, Bloomington.
STUDY OF THE APPLICATION OF ERTS-A IMAGERY TO FRACTURE-RELATED MINE SAFETY HAZARDS IN THE COAL MINING INDUSTRY Progress Report, 1 Sep. - 31 Oct. 1972

Charles E. Wier, Frank J. Wobber, Principal Investigators (Earth Satellite Corp.), Orville R. Russell (Earth Satellite Corp.), and Rojer V. Amato (Earth Satellite Corp.) 8 Nov. 1972 3 p refs
(Contract NAS5-21795)
(E72-10193; NASA-CR-128391; PR-2) Avail: NTIS HC \$3.00 CSCL 08K

The author has identified the following significant results. Various data compilation and analysis activities in support of

ERTS-1 imagery interpretation are in progress or are completed. These include the compilation of mine accident data, areas of mine roof instability and the analysis of high altitude color infrared photography and low altitude color and color infrared photography which was acquired by NASA in support of the project. The photography reveals that many fracture lineaments are detectable through a varied thickness of glacial till. These data will be compiled on a series of 1:250,000 scale base maps and evaluated for a correlation between fracture zones and mine accidents and rooffalls. Due to high occurrence of cloud cover in the project area and to the delay in imagery shipments, little progress has been made in the analysis of ERTS-1 imagery.

N73-10373*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

MAPPING OF THE MAJOR STRUCTURES OF THE AFRICAN RIFT SYSTEM Progress Report 1 Sep. - 31 Oct. 1972

Paul Mohr, Principal Investigator 31 Oct. 1972 3 p
(Contract NAS5-21748)
(E72-10194; NASA-CR-128406) Avail: NTIS HC \$3.00 CSCL 08K

The author has identified the following significant results. ERTS-1 imagery of the African rift system resolves the major Cenozoic faults, zones of warping, and the associated volcanism. It also clearly depicts the crustal grain of the Precambrian rocks where these are exposed. New structural features, or new properties of known features such as greater extent, continuity, linearity, etc., are revealed by the ERTS-1 imagery. This applies to the NE-SW fracture zones in Yemen, the Aswa mylonite zone at the northern end of the Western Rift, the Nandi fault of western Kenya, the arcuate faults of the Elgeyo escarpment in the Gregory rift, and hemi-basins of warped Tertiary lavas on the Red Sea margin of Yemen, matching those of the Ethiopian plateau-Afar margin. A tentative scheme is proposed, relating the effect on the pattern of Cenozoic faulting of the degree of obliquity to Precambrian structural trend. Some ground-mapped lithological boundaries are obscure on ERTS-1 imagery. The present approaches to mapping of Precambrian terrain in Africa may require radical revision with the input of satellite imagery.

N73-10376*# Earth Satellite Corp., Berkeley, Calif.
MINERAL EXPLORATION POTENTIAL OF ERTS-1 DATA. Progress Report

William A. Brewer, Principal Investigator 8 Nov. 1972 6 p
(Contract NAS5-21745)
(E72-10197; NASA-CR-128441) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. Preliminary results of examinations of the ERTS-1 imagery are: (1) although the interpretation was accomplished on a scale of 1:1,000,000, X2 magnification was necessary for greater detail; (2) channel 7 of MSS imagery gave better contrast for detecting geological features; (3) topographic features located south of Phoenix easily identified from surrounding alluvium; (4) granites and granite gneisses in vicinity of Newman Peak cannot be subdivided from examining ERTS-1 imagery; (5) one major lineation, made up of many parallel lineations, is noticeable just north of Lake Pleasant that extends for approximately 100 miles in a northern direction; (6) most of the regional lineations fall into three general directions: northeast, northwest, and north-south; and (7) comparison between image numbers ERTS E 1049-17324-7 and ERTS E 1067-17324-7 is that the latter imagery acquired 18 days later, has higher contrast especially in regards to tracing faults that occur in alluvial fans.

N73-11305*# Kennecott Exploration, Inc., Salt Lake City, Utah. Exploration Services Dept.

RECOGNITION OF THE GEOLOGIC FRAMEWORK FOR COPPER PORPHYRY-TYPE DEPOSITS ON ERTS-1 IMAGERY Progress Report, 30 Jun. - 30 Oct. 1972

John C. Wilson, Principal Investigator 22 Nov. 1972 2 p
(Contract NAS5-21769)
(E72-10210; NASA-CR-128481) Avail: NTIS HC \$3.00 CSCL 08G

04 GEOLOGY AND MINERAL RESOURCES

N73-11312*# Earth Satellite Corp., Berkeley, Calif.
MINERAL EXPLORATION POTENTIAL OF ERTS-1 DATA
 Progress Report, May - Oct. 1972
 William A. Brewer, Principal Investigator, M. C. Erskine, and R. O. Prindle 17 Nov. 1972 7 p refs
 (Contract NAS5-21745)
 (E72-10218; NASA-CR-129084) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. Preliminary analysis of a mosaic composing eight individual ERTS frames (1:1,000,000) extending well beyond the test site has revealed a number of tectonic structural trends that are controlled by regional lineations. So far most of the regional lineations fall into three general directions: east by northeast, northwest, and north-south. From preliminary examination, it appears that the older Precambrian basement predominates in the NE-bearing structural trends, whereas the predominate NW trend is most likely associated with the Texas Structural Zone, and the north-south trend being the Utah-Arizona belt and/or part of the southern Basin and Range Province. One major lineation, made up of many parallel lineations, is noticeable just north of Lake Pleasant which extends for approximately 100 miles in a northern direction out of the target area. This feature corresponds to a Precambrian schist formation shown on the USGS geologic map of Arizona.

N73-11322*# Wyoming Univ., Laramie. Dept. of Geology.
ANALYSIS OF ERTS IMAGERY OF WYOMING AND ITS APPLICATION TO EVALUATION OF WYOMING'S NATURAL RESOURCES Progress Report, Sep. - Oct. 1972
 Robert S. Houston, Principal Investigator and Ronald W. Marrs Nov. 1972 10 p
 (Contract NAS5-21799)
 (E72-10229; NASA-CR-128490; ERTS-1-1-72B) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. The Wyoming ERTS investigation has been hindered only slightly by incomplete ERTS data sets and lack of coverage. Efforts to map cultural development, vegetation distributions, and various geomorphologic features are underway. Tectonic analysis of the Rock Springs area has isolated two linear features that may be very significant with regard to the regional structure of central Wyoming. Studies of the fracture systems of the Wind River Mountains are being completed. The fracture map, constructed from ERTS-1 interpretations, contains a great deal of structural information which was previously unavailable. Mapping of the Precambrian metasedimentary and metavolcanic terrain of the Granite Mountains is nearing completion, and interpretation of ERTS supporting aircraft data has revealed deposits of iron formation.

N73-11328# Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).
[FIELD AND LABORATORY STUDIES, SERVICES, AND PUBLICATIONS ON GEOLOGY, GEOPHYSICS, AND MINERAL RESOURCES] Annual Report, 1971
 1972 104 p refs
 Avail: NTIS HC \$7.25

Data are presented on regional geochemistry, sedimentology, ore genesis, volcanology, and geochronology. Geophysical studies cover design and development of instruments, experimental surveys to evaluate techniques, palaeomagnetism, and mathematical research with evaluation and interpretation. Geological mapping standards are also given. The regional areas studied were Northern and Western Australia and Papua New Guinea. Major exploration was made for evaporite deposits. Author

N73-12332*# Stanford Univ., Calif. School of Earth Sciences.
STRUCTURAL AND LITHOLOGIC STUDY OF NORTHERN CALIFORNIA COAST RANGES AND SACRAMENTO VALLEY, CALIFORNIA
 Ernest I. Rich, Principal Investigator [1972] 2 p Sponsored by NASA
 (E72-10214; NASA-CR-129184) Avail: NTIS HC \$3.00 CSCL 08G

N73-12342*# Geological Survey, Menlo Park, Calif.
INVESTIGATION OF PROTOTYPE VOLCANO-SURVEILLANCE NETWORK Progress Report, 1 Sep. - 31 Oct. 1972
 Jerry P. Eaton, Principal Investigator and Peter L. Ward 1 Nov. 1972 3 p Sponsored by NASA
 (E72-10242; NASA-CR-129119) Avail: NTIS HC \$3.00 CSCL 08E

N73-12346*# Geological Survey, Washington, D.C.
THERMAL SURVEILLANCE OF VOLCANOES OF THE CASCADE RANGE AND ICELAND UTILIZING ERTS DCP SYSTEMS AND IMAGERY Progress Report, 1 Sep. - 31 Oct. 1972
 Jules D. Friedman, Principal Investigator 1 Nov. 1972 5 p Sponsored by NASA
 (E72-10246; NASA-CR-129123) Avail: NTIS HC \$3.00 CSCL 08E

N73-12347*# Geological Survey, Washington, D.C.
REMOTE SENSING OF PERMAFROST AND GEOLOGICAL HAZARDS IN ALASKA Progress Report, 1 Sep. - 31 Oct. 1972
 Oscar J. Ferrians, Jr., Principal Investigator 1 Nov. 1972 3 p Sponsored by NASA
 (E72-10247; NASA-CR-129124) Avail: NTIS HC \$3.00 CSCL 08L

N73-12385*# Colorado School of Mines, Golden. Bonanza Remote Sensing Project.
GEOLOGIC REMOTE SENSING STUDY OF THE HAYDEN PASS-ORIENT MINE AREA, NORTHERN SANGRE DE CRISTO MOUNTAINS, COLORADO
 Daniel C. Wychgram Apr. 1972 68 p refs
 (Grant NGL-08-001-015)
 (NASA-CR-129519; RSP-72-3) Avail: NTIS HC \$5.50 CSCL 08G

Remote sensor data from a NASA Convair 990 radar flight and Mission 101 and 105 have been interpreted and evaluated. Based on interpretation of the remote sensor data, a geologic map has been prepared and compared with a second geologic map, prepared from interpretation of both remote sensor data and field data. Comparison of the two maps gives one indication of the usefulness and reliability of the remote sensor data. Color and color infrared photography provided the largest amount of valuable information. Multiband photography was of lesser value and side-looking radar imagery provided no new information that was not available on small scale photography. Thermal scanner imagery proved to be a very specialized remote sensing tool that should be applied to areas of low relief and sparse vegetation where geologic features produce known or suspected thermal contrast. Low sun angle photography may be a good alternative to side-looking radar imagery but must be flown with critical timing. Author

N73-12406 Imperial Coll. of Science and Technology, London (England).
GEOLOGICAL APPLICATIONS OF SIDE-LOOKING RADAR
 J. W. Norman In Elliott-Automation Space and Advan. Mil. Systems Side-looking Radar Systems and their potential Appl. To Earth Resource Surveys, vol. 3 Aug. 1972 p 64-84 refs

The physical characteristics of rocks are outlined, and the present status of SLR in geology is reviewed. Potential application of SLR in geological mapping, petroleum geology, mineral exploration, and engineering geology are discussed, and recommendations for an experimental program are given. Author (ESRO)

N73-13336*# Institut Francais du Pétrole, Paris (France).
STUDY GEOMORPHOLOGY, PAST AND PRESENT, LINEAR TRENCH, TECTONICS RELATIONSHIP BETWEEN PYRENEES AND ALPS Progress Report, Jul. - Nov. 1972

Jacques Guillemot, Principal Investigator Nov. 1972 6 p
Sponsored by NASA
(E72-10286; NASA-CR-129275; SR-009.03) Avail: NTIS HC
\$3.00 CSCL 08E

N73-13344*# Geological Survey, Washington, D.C.
IRON-ABSORPTION BAND ANALYSIS FOR THE DISCRIMINATION OF IRON-RICH ZONES Progress Report, 1 Sep. - 31 Oct. 1972
Lawrence C. Rowan, Principal Investigator 1 Nov. 1972 4 p
(NASA Order S-70243-AG-4)
(E72-10294; NASA-CR-129286) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. Analysis of ERTS-1 images of Nevada has followed two courses: comparative lineament mapping and spectral reflectance evaluation. The comparative lineament mapping was conducted by mapping lineaments on 9 x 9 inch prints of MSS bands 5 and 7, transferring the data to a base map, and comparing the results with existing geologic maps. The most significant results are that lineaments are more numerous on the band 7 images, and approximately 100 percent more were mapped than appear on existing maps. Geologic significance of these newly mapped lineaments will not be known until they are checked in the field: many are probably faults. Spectral analysis has been limited to visual comparison among the four MSS bands. In general, higher scene contrast is shown in the near infrared bands (6 and 7) than in the visible wavelength bands (4 and 5). The economic implications of these results derive chiefly from the greater efficiency that can be obtained by using near infrared as well as visible wavelength images.

N73-13346*# Geological Survey, Menlo Park, Calif.
IDENTIFICATION OF GEOSTRUCTURES OF CONTINENTAL CRUST PARTICULARLY AS THEY RELATE TO MINERAL RESOURCE EVALUATION Progress Report, 1 Sep. - 31 Oct. 1972
George Gryn, Principal Investigator and Ernest H. Lathram 20 Nov. 1972 6 p refs
(NASA Order S-70243-AG-1)
(E72-10296; NASA-CR-129288) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. Preliminary examination of ERTS-1 imagery in central and northern Alaska substantiates the existence of a conjugate set of northeast and northwest faults suggested by linears noted on Nimbus 4 images. Linears of both trends are well expressed and several have been mapped as faults, including the Shaw Creek fault. Imagery provides new data to support the interpretation that the Kobuk Trench is the northern margin of a broad west-trending fault zone bounded on the north and south by strike-slip faults. In northwestern Alaska, MSS band 5 imagery shows Mississippian limestone as white, while shale, sandstone, and chert of other ages appear dark. As the limestone is the basal formation of the numerous thrust plates stacked in the area, images of band 5 will assist significantly in depicting the distribution of the thrust plates. In south-central Alaska the newly described Totshunda fault is readily identified and extends into areas not yet mapped. Also shown is another fault parallel to the south of the Totshunda which has not yet been recognized in the field.

N73-13347*# Helsinki Univ. (Finland). Dept. of Geology.
MAJOR CRUSTAL FRACTURES IN THE BALTIC SHIELD Progress Report
Heikki V. Tuominen, Principal Investigator 12 Dec. 1972 7 p
Sponsored by NASA
(E72-10297; NASA-CR-129289; PR-1) Avail: NTIS HC
\$3.00 CSCL 08E

The author has identified the following significant results. Initial analysis of the bands for images 1039-09322, 1039-09315, and 1040-09371 provide a detailed picture of a zone extending 500 km north-northeast from the northern coast of the Gulf of Bothnia. Highways (on bands 0.5-0.6 and 0.6-0.7), rivers (bands

0.7-0.8, 0.8-1.1) and bare fell tops are visible. Schist belts, as known from ground surveys, can be discerned from areas occupied by their basement rocks or major plutons. A number of sharp lineaments, apparently faults, are visible. Some major fracture zones, up to 50 km wide, that form distinct lineaments in weather satellite pictures and belong to the main objects of this study, are rather indistinct in the images but can be traced.

N73-13353*# North American Rockwell Corp., Thousand Oaks, Calif. Science Center.
EARTHQUAKE EPICENTERS AND FAULT INTERSECTIONS IN CENTRAL AND SOUTHERN CALIFORNIA Progress Report, Jun. - Nov. 1972
Monem Abdel-Gawad, Principal Investigator and Joel Silverstein Dec. 1972 93 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
(Contract NAS5-21767)
(E72-10304; NASA-CR-129553; SC691-3PR) Avail: NTIS HC \$6.75 CSCL 08K

The author has identified the following significant results. ERTS-1 imagery provided evidence for the existence of short transverse fault segments lodged between faults of the San Andreas system in the Coast Ranges, California. They indicate that an early episode of transverse shear has affected the Coast Ranges prior to the establishment of the present San Andreas fault. The fault has been offset by transverse faults of the Transverse Ranges. It appears feasible to identify from ERTS-1 imagery geomorphic criteria of recent fault movements. Plots of historic earthquakes in the Coast Ranges and western Transverse Ranges show clusters in areas where structures are complicated by interaction of two active fault systems. A fault lineament apparently not previously mapped was identified in the Uinta Mountains, Utah. Part of the lineament show evidence of recent faulting which corresponds to a moderate earthquake cluster.

N73-13355*# Purdue Univ., Lafayette, Ind.
AUTOMATIC MAPPING OF GEOLOGICAL FEATURES FROM ERTS-1 MSS DATA OBTAINED OVER FANNIN COUNTY, TEXAS
Marion F. Baumgardner, D. A. Landgrebe, Principal Investigators, and H. H. Kramer 4 Dec. 1972 1 p
(Contract NAS5-21785)
(E72-10306; NASA-CR-129555) Avail: NTIS HC \$3.00 CSCL 08G

N73-13359*# Iowa Univ., Iowa City.
UTILIZING ERTS-A IMAGERY FOR TECTONIC ANALYSIS THROUGH STUDY OF BIGHORN MOUNTAINS REGION Progress Report
Richard A. Hoppin, Principal Investigator 15 Nov. 1972 5 p
(Contract NAS5-21852)
(E72-10310; NASA-CR-129559) Avail: NTIS HC \$3.00 CSCL 08F

N73-13399# Michigan Univ., Ann Arbor. Inst. of Science and Technology.
TUNNEL-SITE SELECTION BY REMOTE SENSING TECHNIQUES Final Report, 1 Apr. 1971 - 4 Mar. 1972
Thomas Wagner, Robert Vincent, Ben Drake, Ralph Mitchel, and Philip Jackson Sep. 1972 101 p refs
(Contract DI-BM-HO-210041)
(AD-748663; Rept-10018-13-F) Avail: NTIS CSCL 08/7

A study of the role of remote sensing for geologic reconnaissance for tunnel-site selection was commenced. For this study, remote sensing was defined as ultraviolet to thermal infrared multispectral scanning, X- and L-band synthetic aperture radar, and aerial photography. Data from these sensors were processed and evaluated in terms of their complementary use. This report can be used tutorially on the data processing and basic instrumentation of conventional remote sensing. Future research directions are suggested, and the extension of remote sensing to include airborne passive microwave sensor systems, magnetometry, gamma-ray sensors, gravimetry, and airborne electromagnetic sounding systems is discussed. Author (GRA)

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N73-14309*# New York State Museum and Science Service, Albany.

EVALUATION OF ERTS IMAGERY FOR SPECTRAL GEOLOGICAL MAPPING IN DIVERSE TERRAINES OF NEW YORK STATE Progress Report, Jun. - Oct. 1972

Yngvar W. Isachsen, Principal Investigator and Lawrence V. Rickard
20 Oct. 1972 27 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(Contract NAS5-21764)

(E72-10302; NASA-CR-129551; Rept-2) Avail: NTIS HC \$3.50 CSCL 08G

The author has identified the following significant results. Preliminary visual examination of film positives of thirty ERTS-1 scenes obtained over New York State and adjacent areas indicates the following: (1) sixty percent of the imagery has a cloud cover of 70-100 percent, twenty-five percent has a cloud cover of 0-30 percent, and the remainder has a cover of 40-65 percent; (2) on the useable imagery, the spectral lines which may turn out to be geologically-linked totals as follows: spectral linears, 5200 km; broadly curved lines (spectral curvilinears), 700 km; major forest boundaries, 3100 km; areas with spectral geological fabric, 3100 sqkm. In the central and northwest Adirondacks, known lineaments and faults were subtracted from the spectral linears leaving a residue which totals 160 km in the central Adirondacks and 230 km in the northwest Adirondacks. It must be emphasized that these are spectral linears which have not yet been checked out against any ground truth except geological.

N73-14311*# Geological Survey, Corpus Christi, Tex.
MONITORING CHANGING GEOLOGIC FEATURES ALONG THE TEXAS GULF COAST Progress Report, 1 Sep. - 31 Oct. 1972

Ralph E. Hunter, Principal Investigator 1 Dec. 1972 3 p

(NASA Order S-70243-AG-3)

(E72-10323; NASA-CR-129581) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. Water truth observations, NASA aerial photography from an altitude of 60,000 feet, and ERTS-1 imagery made off the South Texas coast showed a mutually consistent pattern of water turbidity in the Gulf of Mexico. At the time of the measurements, plumes of turbid water were being formed by ebb-tidal discharges from the bays through tidal passes and were being diverted southward by the coastwise drift. The occurrence of the bands of turbid and relatively clear water suggests the existence of large scale helical circulation cells having axes almost parallel to shore with the outer turbid band probably being a zone of surface divergence and bottom water upwelling. The impingement of a turbid water mass onto the shoreline suggests that some, and perhaps most, of the suspended sediment in nearshore waters may not have been stirred up from the nearshore sea floor but may have traveled long distances in the water mass, perhaps even having remained in suspension from the time of its entry into the Gulf tidal inlets such as Aransas Pass.

N73-14313*# North Carolina State Univ., Raleigh.
UTILIZATION OF ERTS-A DATA IN GEOLOGICAL EVALUATION REGIONAL PLANNING, FOREST MANAGEMENT, AND WATER MANAGEMENT IN NORTH CAROLINA. 3: MINERAL RESOURCES, GEOLOGICAL STRUCTURES, AND LANDFORM SURVEYS. A: STRUCTURAL SURVEYS

Charles W. Welby, Principal Investigator 15 Dec. 1972 1 p

(Contract NAS5-21732)

(E72-10325; NASA-CR-129583) Avail: NTIS HC \$3.00 CSCL 08G

N73-14315*# Eason Oil Co., Oklahoma City, Okla.
AN EVALUATION OF THE SUITABILITY OF ERTS DATA FOR THE PURPOSES OF PETROLEUM EXPLORATION Interim Report, Jun. - Nov. 1972

Robert Collins, Principal Investigator Dec. 1972 8 p

(Contract NAS5-21735)

(E72-10327; NASA-CR-129585) Avail: NTIS HC \$3.00 CSCL 08G

N73-14320*# Utah Univ., Salt Lake City. Dept. of Geological and Geophysical Sciences.

GEOLOGY OF UTAH AND NEVADA BY ERTS IMAGERY--Progress Report

Mead L. Jensen, Principal Investigator 24 Dec. 1972 25 p refs

(Contract NAS5-21883)

(E72-10332; NASA-CR-129646) Avail: NTIS HC \$3.25 CSCL 08G

The author has identified the following significant results. Imagery for a portion of the study area was received, catalogued for in-house availability, and examined for relevant data. Topographic, geologic, aeromagnetic, and gravity maps were gathered to form a basis of comparison. Overlay drawings were prepared indicating significant features for further study and eventual field checking. The number of significant observations appears to be very great, and it is apparent that methods of handling the acquired information for easy access, for planning field checks, and for final presentation, must be improved. The tracing of lithologic variations and contacts is readily noted on many of the images. Some of the features vary from what is shown on geological maps but the correlation, or lack of same, is still to be studied in the field and by comparison of ground truth geological maps with the specific images. Numerous lineaments, based on tonal differences, are noted in the districts, some of which extend for tens of kilometers. Several positive and negative magnetic anomalies are noted with the suggestion that the sources of the mineralizing fluids were derived from hidden intrusives.

N73-14321*# Stanford Univ., Calif. School of Earth Sciences.
STRUCTURAL AND LITHOLOGIC STUDY OF NORTHERN COAST RANGE AND SACRAMENTO VALLEY, CALIFORNIA

Ernest I. Rich, Principal Investigator 1 Jan. 1973 9 p

(Contract NAS5-21775)

(E72-10333; NASA-CR-129647) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. Preliminary analysis of the data received has disclosed two potentially important northwest-trending systems of linear features within the Northern California Coast Ranges. A third system, which trends northeast, can be traced with great uncertainty across the alluviated part of the Sacramento Valley and into the foothills of the Sierra Nevada. These linear features may represent fault systems or zones of shearing. Of interest, although not yet verified, is the observation that some of the mercury concentrations and some of the geothermally active areas of California may be located at the intersection of the Central and the Valley Systems. One, perhaps two, stratigraphic unconformities within the Late Mesozoic sedimentary rocks were detected during preliminary examination of the imagery; however, more analysis is necessary in order to verify this preliminary interpretation. A heretofore unrecognized, large circular depression, about 15 km in diameter, was detected within the alluviated part of the Sacramento Valley. The depression is adjacent to a large laccolithic intrusion and may be geologically related to it. Changes in the photogeologic characteristics of this feature will continue to be monitored.

N73-14325*# Wyoming Univ., Laramie. Dept. of Geology.
ANALYSIS OF ERTS-1 IMAGERY OF WYOMING AND ITS APPLICATION TO EVALUATION OF WYOMING'S NATURAL RESOURCES Special Report

D. L. Blackstone, Jr. 22 Nov. 1972 8 p refs

(Contract NAS5-21799)

(E72-10337; NASA-CR-129651; ERTS-1-S72-1) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. Structurally linear elements in the vicinity of the Rock Springs Uplift, Sweetwater County, Wyoming are reported for the first time. One element trends N 40 deg W near Farson, Wyoming and the other N 65 deg E from Rock Springs. These elements confirm the block-like or mosaic pattern of major structural elements in Wyoming.

**N73-14327*# Alaska Univ., College.
GLACIOLOGICAL AND VOLCANOLOGICAL STUDIES ON
THE WRANGELL MOUNTAINS, ALASKA Bimonthly
Progress Report**

Carl S. Benson, Principal Investigator 13 Dec. 1972 3 p
(Contract NAS5-21833)
(E72-10339; NASA-CR-129653; BMPR-2) Avail: NTIS HC
\$3.00 CSCL 08F

The author has identified the following significant results. It appears feasible to monitor changes of the summit area on Mt. Wrangell. Data from cycles 1, 2, 3, and 4 over the Wrangell Mountains indicate that the deposition of new snow from storms and its later melting by volcanic heat can be detected. Snow can be removed from the areas on the summit only through melting by volcanic heat. The results of this process can be observed in the ERTS-1 images. Note that these results are based upon first-look analysis only. It is expected in the future to be able to increase the information extracted from the images by the use of enhancement techniques.

**N73-14337*# Wyoming Univ., Laramie. Dept. of Geology.
AN EVALUATION OF ERTS-1 IMAGERY FOR MAPPING
OF MAJOR EARTH FRACTURES AND RELATED FEATURES
Special Report**

Ronald B. Parker 22 Dec. 1972 10 p refs
(Contract NAS5-21799)
(E72-10349; NASA-CR-129688; ERTS-1-S72-2) Avail: NTIS
HC \$3.00 CSCL 08F

The author has identified the following significant results. Fractures of regional extent in the Wind River Mountains of Wyoming were mapped from ERTS-1 imagery. Most previously mapped fractures were confirmed by the ERTS-1 image study, and many new fractures were discovered. In one area, the ERTS-1 imagery appeared to give superior results to ground studies.

**N73-14340*# Alaska Univ., College.
EVALUATION OF FEASIBILITY OF MAPPING SEISMICALLY
ACTIVE FAULTS IN ALASKA Bimonthly Progress Report**

Larry Gedney, Principal Investigator 12 Dec. 1972 8 p
(Contract NAS5-21833)
(E72-10352; NASA-CR-129665; BMPR-2) Avail: NTIS HC
\$3.00 CSCL 08K

The author has identified the following significant results. A previously unmapped seismically active fault has been identified in south-central Alaska on the basis of ERTS-1 imagery. It can be traced for at least 120 km. An unmapped fault was found on the northwest flank of Mt. Sanford that is apparently a reverse fault. A large scale, seismically active fracture system has been identified in central Alaska on the basis of MSS imagery. The system consists of two sets of fractures which intersect at an angle of about 55 degrees. The dominant feature of the system is the Minook Creek fault, on which an earthquake of magnitude 6.5 occurred on October 29, 1968. A possible related feature is a 60 km long lineament near the Toklat River north of Mt. McKinley. These areas are all moderately seismically active. Focal mechanism studies of the 1968 earthquake revealed that left-lateral displacement had occurred on the Minook Creek fault due to compressive stress. A similarly oriented direction of compressive stress could be responsible for the entire fracture system.

**N73-14371*# Nevada Univ., Reno.
REMOTE SENSING EVALUATION OF THE KLONDIKE
MINING DISTRICT, NEVADA. PART 1: GEOLOGY,
PHOTOGRAPHY AND INFRARED**

Peter A. Brennan, Peter E. Chapman, and Eddie R. Chipp 1971
89 p refs
(Contract NAS9-7779)
(NASA-CR-129934; TR-6) Avail: NTIS HC \$6.50 CSCL 08G

During August of 1970 Mission 140 was flown with the NASA P3A aircraft over the Klondike Mining District, Nevada. High quality metric photography, thermal infrared imagery, multispectral photography and multichannel microwave radiometry were obtained. Geology and ground truth data are presented and relationships of the physical attributes of geologic materials

to remotely sensed data is discussed. It is concluded that remote sensing data was valuable in the geologic evaluation of the Klondike Mining District and would be of value in other mining districts.
Author

**N73-15340*# Texas Instruments, Inc., Dallas.
EVALUATION OF COMMERCIAL UTILITY OF ERTS-A
IMAGERY IN STRUCTURAL RECONNAISSANCE FOR
MINERALS AND PETROLEUM Progress Report, 1 Nov.
31 Dec. 1972**

Donald F. Saunders, Principal Investigator 8 Jan. 1973 4 p
(Contract NAS5-21786)
(E73-10004; NASA-CR-129928) Avail: NTIS HC \$3.00 CSCL
08G

The author has identified the following significant results. Initial analytical results in Area 3 have been very encouraging. Not only have new major lineaments been detected but many of the intersections of those lineaments correlate with the general location of known mineral deposits while others appear to outline petroleum-bearing basins and uplifts. If later analyses confirm these results the economic impact of ERTS type imagery could be very significant in worldwide mineral and petroleum reconnaissance.

**N73-15341*# Smithsonian Astrophysical Observatory, Cam-
bridge, Mass.**

**ERTS-1 IMAGERY OF EASTERN AFRICA: A FIRST LOOK
AT THE GEOLOGICAL STRUCTURE OF SELECTED AREAS**
Paul A. Mohr, Principal Investigator 20 Dec. 1972 65 p refs
Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(Contract NAS5-21748)
(E73-10005; NASA-CR-129929; SAO-347; Rept-211-056)
Avail: NTIS HC \$5.25 CSCL 08G

The author has identified the following significant results. Imagery of the African rift system resolves the major Cainozoic faults, zones of warping, and associated volcanism. It also clearly depicts the crystal grain of the Precambrian rocks where these are exposed. New structural features, or new properties of known features such as greater extent, continuity, and linearity are revealed by ERTS-1 imagery. This applies, for example, to the NE-SW fracture zones in Yemen, the Aswa mylonite zone at the northern end of the Western Rift, the Nandi fault of western Kenya, the linear faults of the Elgeyo escarpment in the Gregory Rift, and the hemibasins of warped Tertiary lavas on the Red Sea margin of Yemen, matching those of Ethiopian plateau-Afar margin. A tentative scheme is proposed, relating the effect on the pattern of Cainozoic faulting of the degree of obliquity to Precambrian structural trend. It is particularly noteworthy that, even where the Precambrian grain determines the rift faulting to be markedly oblique to the overall trend of the rift trough, for example, in central Lake Tanganyika, the width of the trough is not significantly increased. Some ground mapped lithological boundaries are obscure on ERTS-1 imagery.

**N73-15351*# New Mexico State Bureau of Mines and Mineral
Resources, Socorro.**

**GEOLOGIC ANALYSIS AND EVALUATION OF ERTS-A
IMAGERY FOR THE STATE OF NEW MEXICO Progress
Report, 14 Nov. 1972 - 14 Jan. 1973**

Frank E. Kottlowski, Principal Investigator 14 Jan. 1973 4 p
(Contract NAS5-21861)
(E73-10015; NASA-CR-129941) Avail: NTIS HC \$3.00
CSCL 08G

**N73-15354*# Earth Satellite Corp., Berkeley, Calif.
MINERAL EXPLORATION POTENTIAL OF ERTS-1 DATA
Progress Report**

William A. Brewer, Principal Investigator 9 Jan. 1973 3 p
(Contract NAS5-21745)
(E73-10018; NASA-CR-129944) Avail: NTIS HC \$3.00 CSCL
08G

04 GEOLOGY AND MINERAL RESOURCES

N73-15356*# Kennecott Exploration, Inc., Salt Lake City, Utah. Exploration Services Dept.

RECOGNITION OF THE GEOLOGIC FRAMEWORK OF PORPHYRY DEPOSITS ON ERTS-1 IMAGERY Progress Report, Nov. - Dec. 1972

John C. Wilson, Principal Investigator and Leslie W. Camp 2 Jan. 1973 5 p

(Contract NAS5-21769)

(E73-10020; NASA-CR-129946) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. Preliminary analysis of a mosaic composing 20 individual ERTS-1 frames that covers most of Nevada and western Utah reveals both new and old structural features. Three separate provinces, the Basin and Range, the southern extension of the Columbia River Plateau volcanics, and the western edge of the Colorado Plateau are easily distinguishable. A west-northwest cross or transverse structural trend, the Las Vegas Shear zone, is present in the region running from the Sierra Nevada to Lake Mead. The Sevier, Hurricane and Grand Wash faults that define the Wasatch-Jerome structural zone, can be traced further on the ERTS-1 imagery than on existing tectonic maps. By use of a stereo viewer on the side-lap coverage of ERTS-1 imagery, it is possible in some instances to determine the direction of sedimentary beds, enabling anticlines and synclines to be mapped. Other geologic features, faults, direction of throw on faults, recent basalt flow contacts with older rhyolitic tuffs, volcanic cones, and subsidences can also be mapped.

N73-15360*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

MAPPING OF THE MAJOR STRUCTURES OF THE AFRICAN RIFT SYSTEM USING ERTS-1 Progress Report, Jul. - Dec. 1972

Paul A. Mohr, Principal Investigator Jan. 1973 7 p

(Contract NAS5-21748)

(E73-10026; NASA-CR-129956) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. The structural margin of western Afar with the Ethiopian plateau is marked by a rather wide zone of crustal deformation. ERTS-1 imagery has now permitted a more precise mapping of the structures of this marginal zone, and in particular of the discontinuous marginal graben. The tectonic style of the graben is different in the north from the south, and in the latter region the graben is discordant with the regional tectonic trend. The structural margin of the southern Afar with the Somali plateau is formed, in the western sector, by a remarkable series of fault-zone splay. Afar-plateau boundary fault-zones successively curve northeast and then NNE to become Afar floor fault-zones, with a distance of about 25 km separating successive turnoffs. The transition from Ethiopian rift to Gulf of Aden trend faulting along this margin is fascinatingly complex. A simplistic crustal thinning model is not adequate to explain all observed structural features of the Afar margins.

N73-15361*# Argus Exploration Co., Newport Beach, Calif. A RECONNAISSANCE SPACE SENSING INVESTIGATION OF CRUSTAL STRUCTURE FOR A STRIP FROM THE EASTERN SIERRA NEVADA TO THE COLORADO PLATEAU Progress Report, 15 Jun. - 31 Dec. 1972

Ira C. Bechtold, Principal Investigator, M. L. Liggett, and J. F. Childs 19 Jan. 1973 31 p refs

(Contract NAS5-21809)

(E73-10082; NASA-CR-129969) Avail: NTIS HC \$3.75 CSCL 08G

There are no author-identified significant results in this report. Research progress in applications of ERTS-1 MSS imagery in study of Basin-Range tectonics is summarized. Field reconnaissance of ERTS-1 image anomalies has resulted in recognition of previously unreported fault zones and regional structural control of volcanic and plutonic activity. NIMBUS, Apollo 9, X-15, U-2, and SLAR imagery are discussed with specific applications, and methods of image enhancement and analysis employed in the research are summarized. Areas studied and methods employed in geologic field work are outlined. A.L.

N73-15364*# New York State Museum and Science Service, Albany.

TO EVALUATE ERTS-1 DATA FOR USEFULNESS AS A GEOLOGICAL SENSOR IN THE DIVERSE GEOLOGICAL TERRANES OF NEW YORK STATE Progress Report, period ending 15 Dec. 1972

Yngvar W. Isachsen, Principal Investigator 15 Dec. 1972 14 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(Contract NAS5-21764)

(E73-10031; NASA-CR-129971) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. In the present imagery, obtained during the full foliage of summer and fall, the greatest amount of spectral geology is displayed in the Adirondack region where bedrock geology is strongly linked to topography. Of the four spectral bands imaged, band 5 and 7 provide the most geological information. The boundary between the basement rocks of the Adirondack Dome and the surrounding Lower Paleozoic rocks is well delineated except in the Northwest Lowlands and along parts of the eastern Adirondacks. Within the basement complex, the most prominently displayed features are numerous north-northeast trending faults and topographic lineaments, and arcuate east-west valleys developed in some of the weaker metasedimentary rocks. The majority of the faults and lineaments shown on the geologic map of New York appear in the ERTS-1 imagery. In addition, many new linears were detected, as well as a number of anomalous curvilinear elements, some circular in plan and measuring up to 25 km in diameter, which do not bear any clear relationship to mapped geological contacts. The possibility that it is an astrobleme will be investigated after snow melts in the spring.

N73-16304*# Colorado School of Mines, Golden.

GEOLOGIC AND MINERAL AND WATER RESOURCES INVESTIGATIONS IN WESTERN COLORADO Progress Report, 30 Nov. 1972 - 31 Jan. 1973

Daniel M. Knepper, Jr., Principal Investigator and Stephen M. Nicolais 29 Jan. 1973 3 p

(Contract NAS5-21778)

(E73-10041; NASA-CR-130320) Avail: NTIS HC \$3.00 CSCL 08G

N73-16320*# Geological Survey, Denver, Colo.

A STUDY OF MORPHOLOGY, PROVENANCE, AND MOVEMENT OF DESERT SAND SEAS IN AFRICA, ASIA, AND AUSTRALIA Progress Report, 1 Jul. - 31 Dec. 1972

Edwin D. McKee, Principal Investigator 1 Jan. 1973 10 p

(NASA Order S-70243-AG)

(E73-10058; NASA-CR-130336) Avail: NTIS HC \$3.00 CSCL 08M

The author has identified the following significant results. The most significant result to date is recognition that complexes are indeed visible on ERTS-1 images, and that the extent and nature of dune fields in many remote areas of the world can, for the first time, be observed almost simultaneously and directly compared. The primary scientific problem is to determine accurately the relationships among certain patterns, trends, and boundaries clearly revealed on ERTS-1 imagery to true surface configurations of desert landforms, and further, to relate the defined features to controlling factors such as wind direction and intensity, moisture in the air and on the ground and barriers to sand movement. It is hoped to produce, by photographic and cartographic extraction from ERTS-1 images, a set of thematic maps that will illustrate the relationships of optical appearance of various materials and effects of the color of various sand bodies upon ERTS-1 images.

N73-16322*# Geological Survey, Denver, Colo.

A STUDY OF MORPHOLOGY, PROVENANCE AND MOVEMENT OF DESERT SAND SEAS IN AFRICA, ASIA AND AUSTRALIA Progress Report, 1 Nov. - 31 Dec. 1972

Edwin D. McKee, Principal Investigator 1 Jan. 1973 6 p

(NASA Order S-70243-AG-4)

(E73-10060; NASA-CR-130310) Avail: NTIS HC \$3.00 CSCL 08M

N73-16332* Argus Exploration Co., Newport Beach, Calif.
REMOTE SENSING RECONNAISSANCE OF FAULTING IN ALLUVIUM, LAKE MEAD TO LAKE HAVASU, CALIFORNIA, NEVADA AND ARIZONA. AN APPLICATION OF ERTS-1 SATELLITE IMAGERY Report of Investigation
 I. C. Bechtold, Principal Investigator, M. A. Liggett, and J. F. Childs Jan. 1973 11 p refs
 (Contract NAS5-21809)
 (E73-10070; NASA-CR-130011) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. Analysis of ERTS-1 MSS and other imagery for a 125 x 25 mile area in the southern part of the Basin-Range Province of southeastern California, southern Nevada, and northwestern Arizona indicates the presence of numerous color and contrast anomalies in alluvium. Field work guided by high altitude U-2 and side-looking aerial radar imagery confirmed that these anomalies are fault zones, many of which are believed to be of recent age. Few faults in alluvium have been reported from previous ground based geologic studies in the area. ERTS-1 imagery provides a synoptic perspective previously unavailable for regional geologic studies. The ability to conduct rapid and inexpensive reconnaissance of recent faulting has important applications to land use planning, ground water exploration, geologic hazards, and the siting and design of engineering projects.

N73-16336* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
APPLICATION OF ERTS AND EREP IMAGES TO GEOLOGIC INVESTIGATIONS OF THE BASIN AND RANGE: COLORADO PLATEAU BOUNDARY IN NORTHWESTERN AND NORTH CENTRAL ARIZONA Progress Report, 15 Oct. - 15 Dec. 1972
 A. F. H. Goetz, Principal Investigator 15 Dec. 1972 4 p
 Sponsored by NASA
 (E73-10074; NASA-CR-130015) Avail: NTIS HC \$3.00 CSCL 08G

N73-16399* Geological Survey, Washington, D.C.
SATELLITE RELAY TELEMETRY OF SEISMIC DATA IN EARTHQUAKE PREDICTION AND CONTROL c07
 Wayne H. Jackson and Jerry P. Eaton /In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 2 1971 p 322-343
 CSCL 09F

The Satellite Telemetry Earthquake Monitoring Program was started to evaluate the applicability of satellite relay telemetry in the collection of seismic data from a large number of dense seismograph clusters laid out along the major fault systems of western North America. Prototype clusters utilizing phone-line telemetry were then being installed by the National Center for Earthquake Research in 3 regions along the San Andreas fault in central California; and the experience of installing and operating the clusters and in reducing and analyzing the seismic data from them was to provide the raw materials for evaluation in the satellite relay telemetry project. The principal advantages of the satellite relay system over commercial telephone or microwave systems were: (1) it could be made less prone to massive failure during a major earthquake; (2) it could be extended readily into undeveloped regions; and (3) it could provide flexible, uniform communications over large sections of major global tectonic zones. Fundamental characteristics of a communications system to cope with the large volume of raw data collected by a short-period seismograph network are discussed. Author

N73-16401* Geological Survey, Denver, Colo.
GEOPHYSICAL ASPECTS OF REMOTE SENSING
 Kenneth Watson /In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 2 1971 p 408-428 refs
 CSCL 08F

Results obtained through the NASA Earth Resources Aircraft Program at Mill Creek, Oklahoma, provide a case history example of the application of remote sensing to the identification of geologic rock units. Thermal infrared images are interpreted by means of

a sequence of models of increasing complexity. The roles of various parameters are examined: rock properties (thermal inertia, albedo, emissivity), site location (latitude), season (sun's declination), atmospheric effects (cloud cover, transmission, air temperature), and topographic orientation (slope, azimuth). The results obtained at this site also illustrate the development of an important application of remote sensing in geologic identification. Relatively pure limestones and dolomites of the Mill Creek test area can be differentiated in nighttime infrared images, and facies changes between them can be detected along and across strike. The predominance on the earth's surface of sedimentary rocks, of which limestone and dolomite are major members, indicates the importance of this discrimination. Author

N73-17288* Iowa Univ., Iowa City.
UTILIZING ERTS-A IMAGERY FOR TECTONIC ANALYSIS THROUGH STUDY OF BIG HORN MOUNTAINS REGION Progress Report, 16 Nov. 1972 - 15 Jan. 1973
 Richard A. Hoppin, Principal Investigator 15 Jan. 1973 3 p
 (Contract NAS5-21852)
 (E73-10036; NASA-CR-129996) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. MSS scene 1085-17294 of the Big Horn region has been subjected to detailed structural analysis. Band 7 is particularly good for revealing structural and drainage patterns because of enhanced topographic detail and the subdued vegetational contrasts. Considerable stereo coverage through sidalap with adjoining scenes adds to the effectiveness of the study and has been used on both positive transparencies and enlarged prints. Negative prints of Band 7 positive transparencies have proven to be much more useful than positive prints because the higher resolution of the positive transparencies can be maintained. The Big Horn Mountains are crisscrossed by a number of prominent topographic linears, most of which can be correlated with known fault and shear zones in the Precambrian crystalline core. Many of these do not appear to continue into the flanking sedimentary rocks and a few that do (Tensleep, Tongue River lineaments) are very difficult to trace farther out into the basins. The Tongue River lineament, long a source of speculation and uncertainty as to its existence, appears as a very prominent discontinuity in the imagery.

N73-17485* Alaska Univ., Fairbanks. Geophysical Inst.
GLACIOLOGICAL AND VOLCANOLOGICAL STUDIES IN THE WRANGELL MOUNTAINS, ALASKA Progress Report, Jul. 1972 - Jan. 1973
 Carl S. Benson, Principal Investigator and Lewis H. Shapiro 20 Feb. 1973 9 p
 (Contract NAS5-21833)
 (E73-10277; NASA-CR-130560) Avail: NTIS HC \$3.00 CSCL 08F

N73-17488* Montana Univ., Missoula. Dept. of Geology.
APPLICABILITY OF ERTS-1 TO MONTANA GEOLOGY Interim Report, Aug. 1972 - Jan. 1973
 Robert M. Weidman, Principal Investigator 19 Feb. 1973 30 p refs
 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
 (Contract NAS5-21826)
 (E73-10280; NASA-CR-130563) Avail: NTIS HC \$3.50 CSCL 08G

The author has identified the following significant results. Geologic maps of four test sites were compiled at 1/250,000. Band 7 prints enlarged to 1/500,000 scale are the best for the purpose, and negative prints provide a valuable supplement. More than 100 mapped lineaments represent most of the major faults of the area and a large number of suspected faults, including many of northeast trend. Under ideal conditions dip slopes may be recognized, laccoliths outlined, and axial traces drawn for narrow, plunging folds. Use of ERTS-1 imagery will greatly facilitate construction of a needed tectonic map of Montana. From ERTS-1 imagery alone, it was possible to identify upturned undivided Paleozoic and Mesozoic strata and to map the boundaries of mountain glaciation, intermontane basins, a volcanic

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field, and an area of granitic rocks. It was also possible to outline clay pans associated with bentonite. However, widespread recognition of gross rock types will be difficult.

N73-17492*# Servicio Geologico de Bolivia, La Paz.
EARTH RESOURCES TECHNOLOGY SATELLITE DATA COLLECTION PROJECT ERTS-A BOLIVIA Progress Report, Sep. 1972 - Jan. 1973
Carlos E. Brockmann, Principal Investigator Jan. 1973 9 p
Sponsored by NASA
(E73-10286; NASA-CR-130569) Avail: NTIS HC \$3.00 CSCL 05B

N73-18321*# Indiana Geological Survey, Bloomington. Coal Section.
APPLICATION OF ERTS-A IMAGERY TO FRACTURE RELATED MINE SAFETY HAZARDS IN THE COAL MINING INDUSTRY Progress Report, Jul. 1972 - Jan. 1973
Charles E. Wier and Frank J. Wobber, Principal Investigators Jan. 1973 52 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
(Contract NAS5-21795)
(E73-10096; NASA-CR-130345) Avail: NTIS HC \$4.75 CSCL 08I

The author has identified the following significant results. The most important result to date is the demonstration of the special value of repetitive ERTS-1 multiband coverage for detecting previously unknown fracture lineaments despite the presence of a deep glacial overburden. The Illinois Basin is largely covered with glacial drift and few rock outcrops are present. A contribution to the geological understanding of Illinois and Indiana has been made. Analysis of ERTS-1 imagery has provided useful information to the State of Indiana concerning the surface mined lands. The contrast between healthy vegetation and bare ground as imaged by Band 7 is sharp and substantial detail can be obtained concerning the extent of disturbed lands, associated water bodies, large haul roads, and extent of mined lands revegetation. Preliminary results of analysis suggest a reasonable correlation between image-detected fractures and mine roof fall accidents for a few areas investigated. ERTS-1 applications to surface mining operations appear probable, but further investigations are required. The likelihood of applying ERTS-1 derived fracture data to improve coal mine safety in the entire Illinois Basin is suggested from studies conducted in Indiana.

N73-18324*# North American Rockwell Corp., Thousand Oaks, Calif. Science Center.
IDENTIFICATION AND INTERPRETATION OF TECTONIC FEATURES FROM ERTS-1 IMAGERY Progress Report, 1 Dec. 1972 - 31 Jan. 1973
Monem Abdel-Gawad, Principal Investigator Feb. 1973 3 p
(Contract NAS5-21767)
(E73-10275; NASA-CR-130509; SC691-4PR) Avail: NTIS HC \$3.00 CSCL 08K

The author has identified the following significant results. Many criteria of active or recent fault movements are observable in the imagery. It was observed that where earthquake epicenter clusters occur, evidence of recent fault movements is generally observed. The opposite was not necessarily true as there are areas where evidence of recent faulting is observed, often along major known faults which are peculiarly devoid of significant seismicity. A tentative conclusion is that the seismicity pattern alone can often be a misleading criteria for potential earthquake hazards. The feasibility of recognizing geomorphic criteria of recent fault movement from ERTS-1 imagery suggests that ERTS imagery should be used to map potentially active faults and utilize this data to develop better criteria for the identification of areas prone to future earthquakes. An apparent correlation was observed between the distribution of mercury deposits in the California Coast Range Province and transverse fault zones trending west-northwest oblique to the trend of the San Andreas system. The significance of this correlation and the full extent of its implication on mercury exploration is under study.

N73-18325*# Montana Univ., Missoula. Dept. of Geology.
APPLICABILITY OF ERTS-1 TO MONTANA GEOLOGY Progress Report, period ending 30 Nov. 1972
Robert M. Weidman, Principal Investigator 19 Feb. 1973 2 p
(Contract NAS5-21826)
(E73-10281; NASA-CR-130564) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. Rapid construction of a lineament map for western Montana, drawn as an overlay to a late August band 7 mosaic at a scale of 1:1,000,000 indicates ERTS-1 imagery to be very suitable for quick compilation of topographically expressed lineaments representing scarps and straight canyons. Over 100 such lineaments were detected, ranging in length from 80 down to 5 miles. Most of the major high angle faults of the area are represented, but low angle faults such as the Lewis overthrust are not apparent. Short and medium length lineaments of northeast trend are abundant southeast of a line connecting Missoula and Great Falls. Only about half of the lineaments are shown on the state geologic map, and limited comparisons with more detailed maps suggest that many will merit investigation as possible faults. It is already apparent that ERTS-1 imagery will be useful in construction of a needed tectonic map of Montana.

N73-18326*# Alaska Univ., Fairbanks. Geophysical Inst.
EVALUATION OF FEASIBILITY OF MAPPING SEISMICALLY ACTIVE FAULTS IN ALASKA Progress Report, Jul. 1972 - Jan. 1973
Larry D. Gedney, Principal Investigator and James D. VanWormer 20 Feb. 1973 12 p refs
(Contract NAS5-21833)
(E73-10283; NASA-CR-130566) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. ERTS-1 imagery is proving to be exceptionally useful in delineating structural features in Alaska which have never been recognized on the ground. Previously unmapped features such as seismically active faults and major structural lineaments are especially evident. Among the more significant results of this investigation is the discovery of an active strand of the Denali fault. The new fault has a history of scattered activity and was the scene of a magnitude 4.8 earthquake on October 1, 1972. Of greater significance is the disclosure of a large scale conjugate fracture system north of the Alaska Range. This fracture system appears to result from compressive stress radiating outward from around Mt. McKinley. One member of the system was the scene of a magnitude 6.5 earthquake in 1968. The potential value of ERTS-1 imagery to land use planning is reflected in the fact that this earthquake occurred within 10 km of the site which was proposed for the Rampart Dam, and the fault on which it occurred passes very near the proposed site for the bridge and oil pipeline crossing of the Yukon River.

N73-18330*# New York State Museum and Science Service, Albany.
TO EVALUATE ERTS-1 DATA FOR USEFULNESS AS A GEOLOGICAL SENSOR IN THE DIVERSE GEOLOGICAL TERRANES OF NEW YORK STATE Progress Report, period ending 15 Feb. 1973
Y. W. Isachsen, Principal Investigator 15 Feb. 1973 6 p
(Contract NAS5-21764)
(E73-10298; NASA-CR-130554) Avail: NTIS HC \$3.00 CSCL 08G

N73-18333*# Wyoming Univ., Laramie. Remote Sensing Lab.
DISTINGUISHING MAJOR LITHOLOGIC TYPES IN ROCKS OF PRECAMBRIAN AGE IN CENTRAL WYOMING USING MULTILEVEL SENSING, WITH A CHAPTER ON POSSIBLE ECONOMIC SIGNIFICANCE OF IRON FORMATION DISCOVERED BY USE OF AIRCRAFT IMAGES IN THE GRANITE MOUNTAINS OF WYOMING Special Report
Robert S. Houston, Principal Investigator 16 Feb. 1973 34 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(Contract NAS5-21799)

(E73-10301; NASA-CR-130557; ERTS-1-572-3) Avail: NTIS HC \$3.75 CSCL 08G

The author has identified the following significant results. Information obtained by remote sensing from three altitude levels: ERTS-1 (565 miles), U-2 (60,000 feet), and C-130 aircraft (15,000 feet) illustrates the possible application of multilevel sensing in mineral exploration. Distinction can be made between rocks of greenstone belts and rocks of granite-granite gneiss areas by using ERTS-1 imagery in portions of the Precambrian of central Wyoming. Study of low altitude color and color infrared photographs of the mafic terrain revealed the presence of metasedimentary rocks with distinct layers that were interpreted as amphibolite by photogeologic techniques. Some of the amphibolite layers were found to be iron formation when examined in the field. To our knowledge this occurrence of iron formation has not been previously reported in the literature.

N73-18341*# Wyoming Univ., Laramie. Remote Sensing Lab. COOPERATIVE PROPOSAL TO STUDY THE GEOLOGY OF A TEST SITE IN THE ICE FREE VALLEYS OF ANTARCTICA Progress Report

Robert S. Houston, Principal Investigator 1 Mar. 1973 7 p refs

(Contract NAS5-21818)

(E73-10309; NASA-CR-130727) Avail: NTIS HC \$3.00 CSCL 08G

N73-18345*# Utah Univ., Salt Lake City. Dept. of Geological and Geophysical Sciences.

GEOLOGY OF UTAH AND NEVADA BY ERTS IMAGERY Progress Report

Mead L. Jensen, Principal Investigator 21 Feb. 1973 7 p

(Contract NAS5-21883)

(E73-10313; NASA-CR-130731; PR-2) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. Two ancient watercourses have been observed on ERTS-1 imagery. These lie in the Waterpocket Fold area, north of the Marble Canyon section of the Colorado River, in Arizona and Utah. A third old watercourse of interest is an ancient canyon of the Colorado and is located on image no. 1156-17260. Image no. 1051-17414 contains some very useful information concerning the hydrology, sedimentology, and biology of Great Salt Lake and Bear Lake in Utah. In Great Salt Lake, there is a sharp line between the portion of the lake north of the railroad causeway and that south of the causeway. There is a marked difference in salinity across the causeway, and this is reflected in different algal species. On the same image, sediment plumes in Bear Lake clearly delineate the circulation pattern, and provide excellent indications of bottom contours over much of the area. Image no. 1051-17420 contains part of Great Salt Lake and all of Utah Lake. The latter displays a very interesting surface pattern which is probably due to an algal bloom which has been swirled into a spiral by the circulation of the lake.

N73-18349*# Geological Survey, Washington, D.C. THERMAL SURVEILLANCE OF VOLCANOES OF THE CASCADE RANGE AND ICELAND UTILIZING ERTS DCP SYSTEMS AND IMAGERY Progress Report, 1 Jul. - 31 Dec. 1972

Jules D. Friedman, Principal Investigator 1 Jan. 1973 10 p

(NASA Order S-70243-AG)

(E73-10317; NASA-CR-130735) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. Significant results of the thermal surveillance of volcanoes experiment during 1972 included the design, construction, emplacement, and successful operation at volcanic sites in the Cascade Range, North America and on Surtsey, Iceland, of automated thermistor arrays which transmit ground and fumarole temperatures via the ERTS-1 data communication system to Goddard Space Flight Center. Temperature, radiance, and anomalous heat flow variations are being plotted by a U.S.

Geological Survey IBM 360/65 computer program to show daily fluctuations at each of the sites. Results are being compiled in conjunction with NASA and USGS aircraft infrared survey data to provide thermal energy yield estimates during the current repose period of several Cascade Range volcanic systems. ERTS-1 MSS images have provided new information on the extent of structural elements controlling thermal emission at Lassen Volcanic National Park.

N73-18352*# Geological Survey, Menlo Park, Calif.

REMOTE SENSING OF PERMAFROST AND GEOLOGIC HAZARDS IN ALASKA Progress Report, 1 Jul. - 31 Dec. 1972

Oscar J. Ferrians, Jr., Principal Investigator 1 Jan. 1973 4 p (NASA Order S-70243-AG-2)

(E73-10320; NASA-CR-130738) Avail: NTIS HC \$3.00 CSCL 08L

N73-18353*# Geological Survey, Menlo Park, Calif.

IDENTIFICATION OF GEOSTRUCTURES OF CONTINENTAL CRUST PARTICULARLY AS THEY RELATE TO MINERAL RESOURCE EVALUATION Progress Report, 1 Jul. - 31 Dec. 1972

George Gryc, Principal Investigator and Ernest H. Latham 31 Dec. 1972 5 p

(NASA Order S-70243-AG-1)

(E73-10321; NASA-CR-130739) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. Lakes in the Arctic Coastal Plain of Alaska are dominantly elongate, with their long axes parallel and trending about N 9 W. On ERTS-1 imagery, an additional strong east-trending regional lineation, not previously recognized on aerial photographs or in field study, was noted. In addition, the alignment of many small lakes forms a large and a small ellipse superimposed on the regional lineation. Fischer and Latham find that the trend of this lineation is parallel to the trend of deflections in contours of the magnetic and gravity fields in the area, and parallel to westerly deflections in the northwest ends of northwest-trending folds mapped to the south. These data suggest that heretofore unsuspected structures may be concealed beneath Quaternary mantling sediments in the area of the image. The strata in these folds would be younger than those tapped by the oil wells of the Umiat field to the south, and favorable sandstone facies may occur in the area. The significance of these observations to oil exploration in northern Alaska needs to be evaluated further.

N73-18354*# Eason Oil Co., Oklahoma City, Okla.

AN EVALUATION OF THE SUITABILITY OF ERTS DATA FOR THE PURPOSES OF PETROLEUM EXPLORATION Progress Report, Dec. 1972 - Jan. 1973

Robert J. Collins, Jr., Principal Investigator 7 Mar. 1973 4 p

(Contract NAS5-21735)

(E73-10322; NASA-CR-130740) Avail: NTIS HC \$3.00 CSCL 08G

N73-18365*# National Center for Earthquake Research, Menlo Park, Calif.

INVESTIGATION OF PROTOTYPE VOLCANO SURVEILLANCE NETWORK Progress Report, 1 Jul. - 31 Dec. 1972

Jerry P. Eaton, Principal Investigator and Peter L. Ward 1 Jan. 1973 4 p

(NASA Order S-70243-AG-2)

(E73-10337; NASA-CR-130787) Avail: NTIS HC \$3.00 CSCL 08F

N73-18366*# Geological Survey, Washington, D.C.

IRON ABSORPTION BAND ANALYSIS FOR THE DISCRIMINATION OF IRON RICH ZONES Progress Report, 1 Jul. - 31 Dec. 1972

Lawrence C. Rowan, Principal Investigator 30 Jan. 1973 12 p (NASA Order S-70243-AG)

(E73-10338; NASA-CR-130788) Avail: NTIS HC \$3.00 CSCL 08G

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The author has identified the following significant results. A lineament study of the Nevada test site is near completion. Two base maps (1:500,000) have been prepared, one of band 7 lineaments and the other of band 5 lineaments. In general, more lineaments and more faults are seen on band 5. About 45% of the lineaments appear to be faults and contacts, the others being predominantly streams, roads, railway tracks, and mountain crests. About 25% of the lineaments are unidentified so far. Special attention is being given to unmapped extensions of faults, groups of unmapped lineaments, and known mineralized areas and alteration zones. Earthquake epicenters recorded from 1869 to 1963 have been plotted on the two base maps. Preliminary examination as yet indicates no basic correlation with the lineaments. Attempts are being made to subtract bands optically, using an I2S viewer, an enlarger, and a data color viewer. Success has been limited so far due to technical difficulties, mainly vignetting and poor light sources, within the machines. Some vegetation and rock type differences, however, have been discerned.

N73-18370*# Martin Marietta Corp., Denver, Colo.
APPLICATION OF REMOTE SENSOR DATA TO GEOLOGIC ANALYSIS OF THE BONANZA TEST SITE, COLORADO
Semiannual Progress Report, 1 Apr. - 30 Sep. 1972
Keenan Lee, comp. Dec. 1972 37 p refs Prepared in cooperation with Colo. School of Mines, Golden
(Grant NGL-06-001-015)
(NASA-CR-130822; Rept-72-7) Avail: NTIS HC \$4.00 CSCL 08G

A variety of remote sensor data has aided geologic mapping in central Colorado. This report summarizes the application of sensor data to both regional and local geologic mapping and presents some conclusions on the practical use of remote sensing for solving geologic mapping problems. It is emphasized that this study was not conducted primarily to test or evaluate remote sensing systems or data, but, rather, to apply sensor data as an accessory tool for geologic mapping. The remote sensor data used were acquired by the NASA Earth Observations Aircraft Program. Conclusions reached on the utility of the various sensor data and interpretation techniques for geologic mapping were by-products of attempts to use them. Author

N73-19333*# Servicio Geologico de Bolivia, La Paz.
SKETCH ON THE STRUCTURAL GEOLOGY AND VOLCANISM IN THE CENTRAL HIGH PLATEAU OF THE BOLIVIAN ANDES [BOQUEJO SOBRE LA GEOLOGIA ESTRUCTURAL Y EL VOLCANISMO EN EL ALTIPLANO CENTRAL DE LOS ANDES BOLIVIANOS]
Carlos E. Brockmann, Principal Investigator Jan. 1973 18 p
In SPANISH Sponsored by NASA
(E73-10296; NASA-CR-130791) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. The Earth Resources Technology Satellite Program has as an objective the development of tectonic maps for Bolivia. Maps were prepared using the images of ERTS-1 in a preliminary study of alignments observed and rapidly interpreted in images 1010-14033-3-4-5-6-7 on a scale of 1:1,000,000, and later verified on the ground with corresponding fault zones. This information was not shown on existing geological maps. The ERTS-1 imagery was used in volcanology research for drawing the regional limits of volcanic formations as soon as the alignment and the extent of the volcanoes could be determined. The extensive coverage of ERTS-1 images provides an excellent opportunity for developing studies of regional structures. Transl. by F.O.S.

N73-19334*# Spectral Africa (Pty) Ltd., Randfontein (Republic of South Africa).
GROWTH AND DECLINE OF VEGETATION ON MINE DUMPS
Progress Report, Nov. 1972 - Jan. 1973
B. P. Gilbertson, Principal Investigator Jan. 1973 32 p
Sponsored by NASA Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
(E73-10326; NASA-CR-130781; Rept-73-3) Avail: NTIS HC \$3.75 CSCL 08F

The author has identified the following significant results. The main objective is to determine the extent to which can be used to differentiate between mine dumps having varying degrees of vegetative cover. At this stage it is clear that the various mine dumps can be located and identified. Differences in vegetative cover can be seen and measured. Patterns of vegetative growth, some characteristic to particular dumps, can also be seen. It is therefore tentatively concluded that mine dumps can be differentiated with respect to their vegetative cover on the imagery received to date, and this is reported as a significant result. Subsequent imagery showing seasonal variations should facilitate this program. In addition to work on the mine dumps, a photogeological project has been initiated on geotectonics of South Africa. Studies of ERTS-1 images has indicated that major structures (faults, folds, and linear features) associated with the three geotectonic environments can be identified. In addition, major as well as relatively minor stratigraphic subdivisions can be recognized by their color tones. Results obtained warrant continuation of this study using color composite prints enlarged to a scale of 1:500,000.

N73-19347*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
AN INTERDISCIPLINARY ANALYSIS OF ERTS DATA FOR COLORADO MOUNTAIN ENVIRONMENTS USING ADP TECHNIQUES
Bimonthly Progress Report, 1 Jan. - 28 Feb. 1973
R. M. Hoffer, Principal Investigator 28 Feb. 1973 8 p
(Contract NAS5-21880)
(E73-10348; NASA-CR-130815) Avail: NTIS HC \$3.00 CSCL 08F

N73-19351*# Argus Exploration Co., Newport Beach, Calif.
A RECONNAISSANCE SPACE SENSING INVESTIGATION OF CRUSTAL STRUCTURE FOR A STRIP FROM THE EASTERN SIERRA NEVADA TO THE COLORADO PLATEAU
Progress Report, 1 Jan. - 28 Feb. 1973
Ira C. Bechtold, Principal Investigator 15 Mar. 1973 9 p
(Contract NAS5-21809)
(E73-10355; NASA-CR-130970) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. Analysis of ERTS-1 MSS imagery over the southern Basin-Range Province of California, Nevada, and Arizona has led to recognition of regional tectonic control of volcanism, plutonism, mineralization, and fault patterns. This conclusion is the result of geologic reconnaissance of anomalies observed in ERTS-1 and Apollo-9 data, guided by intermediate scale U-2 photography, SLAR, and relevant geologic literature. In addition to regional tectonic studies, the ERTS-1 imagery provides a basis for detailed research of relatively small geologic features. Interpretation of ERTS-1 and Apollo-9 space imagery and intermediate scale X-15 and U-2 photography indicates the presence of a major fault zone along the California-Nevada state line, here named the Pahrump fault zone. Field mapping confirms previously unreported evidence of fault breaks in bedrock, along range fronts and in Quaternary alluvium and lake sediments. Regional gravity lows and fault traces within the Pahrump fault zone from a general left stepping en echelon pattern. The trend and postulated displacement for this fault are similar to other major strike slip fault zones in the southern Basin-Range Province. A.L.

N73-19354*# New Mexico State Bureau of Mines and Mineral Resources, Socorro.
GEOLOGICAL ANALYSIS AND EVALUATION OF ERTS-A IMAGERY FOR THE STATE OF NEW MEXICO
Progress Report, 23 Jul. 1972 - 14 Mar. 1973
Frank E. Kottowski, Principal Investigator 14 Mar. 1973 10 p
(Contract NAS5-21861)
(E73-10358; NASA-CR-130973) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. Coverage of approximately one-third of the test site had been received by January 31, 1973 and all of the images received were MSS products. Images recorded during the first two months of the ERTS-1 mission were of poor quality, owing largely to

high ground reflectance. Later images were of better quality and MSS bands 5 and 7 have proven to be particularly useful. Features noted during visual inspection of 9 1/2 x 9 1/2 prints include major structural forms, vegetation patterns, drainage patterns, and outcrops of geologic formations having marked color contrasts. The Border Hills Structural Zone and the Y-O Structural Zone are prominently reflected in coverage of the Pecos Valley. A study of available maps and remote sensing material covering the Deming-Columbus area indicated that the limit of detection and the resolution of MSS products are not as good as those of aerial photographs, geologic maps, and manned satellite photographs. The limit of detection of high contrast features on MSS prints is approximately 1000 feet or 300 meters for linear features and about 18 acres for roughly circular areas.

N73-19366*# Earth Satellite Corp., Washington, D.C.
STUDY OF APPLICATION OF ERTS-A IMAGERY TO FRACTURE RELATED MINE SAFETY HAZARDS IN THE COAL MINING INDUSTRY Progress Report, 1 Jan. - 1 Mar. 1973
 Charles E. Wier, Frank J. Wobber, Principal Investigators, Orville R. Russell, and Roger Amato 16 Mar. 1973 10 p Prepared for Ind. Geol. Surv.
 (Contract NAS5-21795)
 (E73-10371; NASA-CR-131012) Avail: NTIS HC \$3.00 CSCL 081

The author has identified the following significant results. The utility of ERTS-1/high altitude aircraft imagery to detect underground mine hazards is strongly suggested. A 1:250,000 scale mined lands map of the Vincennes Quadrangle, Indiana has been prepared. This map is a prototype for a national mined land inventory and will be distributed to State and Federal offices.

N73-19376*# Geological Survey, Denver, Colo.
EVALUATION OF ERTS-1 IMAGERY FOR MAPPING QUATERNARY DEPOSITS AND LANDFORMS IN THE GREAT PLAINS AND MIDWEST Progress Report, 1 Jul. - 31 Dec. 1972
 Roger B. Morrison, Principal Investigator and George R. Hallberg (Iowa Geol. Surv., Iowa City) 1 Jan. 1973 27 p
 (NASA Order S-72043-AG)
 (E73-10381; NASA-CR-131022) Avail: NTIS HC \$3.50 CSCL 08B

The author has identified the following significant results. The main landform associations and larger landforms are readily identifiable on the better images and commonly the gross associations of surficial Quaternary deposits also can be differentiated, primarily by information on landforms and soils. Maps showing the Quaternary geologic-terrain units that can be differentiated from the ERTS-1 images are being prepared for 20-odd potential study areas in Illinois, Iowa, Missouri, Kansas, Nebraska, and South Dakota. Among the more distinct features are the major moraines and outwash channels of the last (Wisconsin) glaciation. Analysis of dissection/drainage patterns from the synoptic imagery is proving useful for detecting anomalies that may be caused by stream diversions and moraines of pre-Wisconsin glaciations, by variable loess deposition, by tectonism, and other factors. Numerous abandoned river valleys have been mapped. Trend-lines of several known pre-Wisconsin moraine systems have been identified in Iowa, Nebraska, and Kansas, and also several similar trend-lines, that may indicate previously unknown moraine systems of middle and possibly early Pleistocene age, have been found in Iowa and Missouri. The area inundated by a major flood in southwestern Iowa also has been delineated from ERTS-1 imagery.

N73-19377*# Geological Survey, Denver, Colo.
APPLICATION OF ERTS-1 IMAGERY TO DETECTING AND MAPPING MODERN EROSION FEATURES, AND TO MONITORING EROSIONAL CHANGES, IN SOUTHERN ARIZONA Progress Report, 15 Jul. 1972 - 31 Jan. 1973
 Roger B. Morrison and Maurice E. Cooley 1 Feb. 1973 14 p
 (NASA Order S-70243-AG)

(E73-10382; NASA-CR-131023) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. The red MSS band 5 gives the sharpest definition of modern arroyos. On the best images, modern arroyos can be distinguished as narrow as 150 to 200 feet in reaches where their contrast with adjacent areas is only moderate, and as narrow as 60 to 75 feet where their contrast is high. Both the red and infrared bands show differences in soils and vegetation. In the late fall and winter imagery, band 7 generally is the most useful for mapping the areas of the more erodible soils. A map at 1:1,000,000 scale has been prepared that shows all the arroyos within the 17,000 square mile study area that have been identified from ERTS-1 images. Also, from U-2 color infrared airphotos, a 1:125,000 scale map has been made of a 50 mile reach along San Simon Wash, in southeastern Arizona. This map shows not only the arroyo channels and narrow flood plains that have developed since 1890, but also areas within a few miles of the wash that are severely gullied, severely sheet-eroded, and moderately sheet-eroded. Two important effects of the third largest recorded flood of the upper Gila River also have been determined from the ERTS-1 images. The inundated area is best displayed on band 7, and the areas of severe sand/gravel erosion/deposition show best on band 5.

N73-20356* Environmental Research Inst. of Michigan, Ann Arbor.

TASK 10: AN ERTS EXPERIMENT FOR MAPPING IRON COMPOUNDS, 1383

R. K. Vincent, Principal Investigator *In its Process*, and Analysis of ERTS-1 Remotely Sensed Data 15 Mar. 1973 9 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 (For availability see N73-20349 11-13)
 (E73-10397) CSCL 08B

The author has identified the following significant results. Preliminary results of a spectral ratioing technique are shown for a region at the southern end of the Wind River Range, Wyoming. Digital ratio graymaps and analog ratio images have been produced for the test site, but ground truth is not yet available for thorough interpretation of these products. ERTS-1 analog ratio images were found generally better than either ERTS-1 single channel images or high altitude aerial photos for the discrimination of vegetation from non-vegetation in the test site region. Some linear geological features smaller than the ERTS-1 spatial resolution are seen as well in ERTS-1 ratio and single channel images as in high altitude aerial photography. Geochemical information appears to be extractable from ERTS-1 data. Good preliminary quantitative agreement between ERTS-1 derived ratios and laboratory derived reflectance ratios of rocks and minerals encourage plans to use lab data as training sets for a simple ratio gating logic approach to automatic recognition maps. Empirical atmospheric corrections indicate that atmospheric corrections are needed to make the ratio method, and possibly other types of data processing, consistent over large geographical and temporal displacements.

N73-20366*# Alaska Univ., Fairbanks.
GLACIOLOGICAL AND VOLCANOLOGICAL STUDIES IN THE WRANGELL MOUNTAINS, ALASKA Bimonthly Progress Report

Carl S. Benson, Principal Investigator 31 Mar. 1973 2 p
 (Contract NAS5-21833)
 (E73-10404; NASA-CR-131140; BMPR-4) Avail: NTIS HC \$3.00 CSCL 08F

N73-20367*# Alaska Univ., Fairbanks.
EVALUATION OF FEASIBILITY OF MAPPING SEISMICALLY ACTIVE FAULTS IN ALASKA Bimonthly Progress Report
 Larry Gedney, Principal Investigator 31 Mar. 1973 4 p
 (Contract NAS5-21833)
 (E73-10405; NASA-CR-131141; BMPR-4) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. The Yukon-Tanana uplands north and east of Fairbanks appear, on ERTS-1 imagery, to be composed of a number of large-scale

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(approximately 100 kilometers square) crustal blocks. The boundaries of these blocks appear to be defined by a number of northeast-striking lineaments which form the major river valleys of the area. Principal among these are the valleys of the Salcha River, the Cohan River, and the Chatanika River. These lineaments are all seismically active, and are thus presumed to be faults. This parallel set of lineaments appears to be intersected at various angles by a secondary set of faults trending generally north to south. The larger earthquakes in the area occur at the intersections of the two sets. It appears that seismicity of this part of Alaska may be conceptually represented by the grinding together of rigid blocks, with earthquakes occurring along their common boundaries and at the intersections where three or more blocks come in contact.

N73-20376*# Texas Instruments, Inc., Dallas.

ERTS-1 IMAGERY USE IN RECONNAISSANCE PROSPECTING: EVALUATION OF COMMERCIAL UTILITY OF ERTS-1 IMAGERY IN STRUCTURAL RECONNAISSANCE FOR MINERALS AND PETROLEUM Interim Report, 29 Aug. 1972 - 28 Feb. 1973

Donald F. Saunders, Principal Investigator, G. L. Thomas, and F. E. Kinsman Mar. 1973 32 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 (Contract NAS5-21796)

(E73-10414; NASA-CR-131150) Avail: NTIS HC \$3.75 CSCL 08G

The author has identified the following significant results. Five areas in North America (North Slope - Alaska, Superior Province - Canada, Williston Basin - Montana, Colorado, and New Mexico - West Texas) are being studied for discernibility of geological evidence on ERTS-1 imagery. Evidence mapped is compared with known mineral/hydrocarbon accumulations to determine the value of the imagery in commercial exploration programs. Evaluation has proceeded in the New Mexico - Texas area, and to date, results have been better than expected. Clearly discernible structural lineaments in this area are evident on the photographs. Comparison of this evidence with known major mining localities in New Mexico indicates a clear pattern of coincidence between the lineaments and mining localities. In West Texas, lineament and geomorphological evidence obtainable from the photographs define the petroleum-productive Central Basin Platform. Based on evaluation of results in the New Mexico - West Texas area and on cursory results in the other four areas of North America, it is concluded that ERTS-1 imagery will be extremely valuable in defining the regional and local structure in any commercial exploration program.

N73-20382*# Iowa Univ., Iowa City.

UTILIZING ERTS-A IMAGERY FOR TECTONIC ANALYSIS THROUGH STUDY OF THE BIGHORN MOUNTAINS REGION Progress Report, 15 Sep. 1972 - 15 Mar. 1973

Richard A. Hoppin, Principal Investigator 15 Mar. 1973 7 p (Contract NAS5-21852) (E73-10420; NASA-CR-131210) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. Preliminary vegetation analysis has been undertaken on MSS scene 1085-17294, Oct. 16, 1973 in the Bighorn region. Forest Service maps showing detailed distribution of dominant forest types have been compared with MSS bands 5 and 7 positive transparencies, enlarged positive prints, and color imagery produced on an Addcol viewer. Patterns on the ERTS imagery match those on the Forest Service maps quite well. A tectonic map overlay of MSS band 7 of the Bighorn region reveals a strong concentration of linears in the uplift as compared to basins. Folds in the Bighorn Basin are visible where not covered by post-Paleocene deposits. In regions where far less is known of the geology than in this area, it might be possible to predict the subsurface occurrence of folds and lineaments on the basis of imagery analysis and more confidently explore covered areas for concealed oil structures and mineral deposits.

N73-20383*# Colorado School of Mines, Golden. Dept. of Geology.

GEOLOGIC AND MINERAL AND WATER RESOURCES INVESTIGATIONS IN WESTERN COLORADO Progress Report, 1 Feb. - 31 Mar. 1973

Daniel H. Knepper, Principal Investigator 28 Mar. 1973 8 p (Contract NAS5-21778) (E73-10422; NASA-CR-131212) Avail: NTIS HC \$3.00 CSCL 08G

N73-20392*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

MAPPING OF THE MAJOR STRUCTURES OF THE AFRICAN RIFT SYSTEM Progress Report, 1 Jan. - 28 Feb. 1973

Paul Mohr, Principal Investigator 28 Feb. 1973 3 p refs (Contract NAS5-21748) (E73-10431; NASA-CR-131221) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. Lake Tara lies within a previously recognized asymmetric graben situated on the Ethiopian plateau and about 250 km west of the plateau-Afar margin. ERTS-1 imagery confirms the stronger deformation of the western side of the Tara graben, with intense faulting and some associated monoclinical mapping extending between latitudes 12 deg and 14 deg N, and lying close to meridian 37 deg E. The zone of deformation is gently arcuate in plan, trending NNE in the south NNW in the north. In the north, the Quaternary faulting dies out in the alluvial plains of the Takazze Valley; in the south the faulting appears to die out in coincidence with a large erosional escarpment trending S30W from Lake Tara to precisely latitude 11 deg N. This escarpment aligns with the massive NE-SW escarpment of western Simien, northeast of Lake Tara, and may represent erosional recession from major faulting and tilting much older than that of the superimposed, obliquely trending Tara graben. A 30 km diameter circular feature has been identified from the ERTS-1 imagery of the Tara graben, centered on 13 deg 05 min N, 37 deg 20 min E. ERTS-1 imagery further shows that the Tara graben and its associated young volcanics have no direct connection with the Red Sea or Ethiopian rift valley.

N73-20401*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

APPLICATION OF ERTS AND EREP IMAGES TO GEOLOGIC INVESTIGATIONS OF THE BASIN AND RANGE: COLORADO PLATEAU BOUNDARY IN NORTHWESTERN AND NORTH CENTRAL ARIZONA Progress Report, 15 Dec. 1972 - 15 Feb. 1973

A. F. H. Goetz, Principal Investigator, F. C. Billingsley, D. P. Elston (Geol. Surv., Flagstaff, Ariz.), I. Lucchitta (Geol. Surv., Flagstaff, Ariz.), and E. M. Shoemaker (Calif. Inst. of Tech., Pasadena) 26 Mar. 1973 10 p Sponsored by NASA (E73-10441; NASA-CR-131235) Avail: NTIS HC \$3.00 CSCL 08G

N73-20404*# Eason Oil Co., Oklahoma City, Okla.

AN EVALUATION OF THE SUITABILITY OF ERTS DATA FOR THE PURPOSES OF PETROLEUM EXPLORATION Progress Report, Feb. - Mar. 1973

Robert J. Collins, Principal Investigator 9 Apr. 1973 2 p (Contract NAS5-21735) (E73-10444; NASA-CR-131239) Avail: NTIS HC \$3.00 CSCL 08G

N73-20406*# Rockwell International Science Center, Thousand Oaks, Calif.

IDENTIFICATION AND INTERPRETATION OF TECTONIC FEATURES FROM ERTS-1 IMAGERY Progress Report, 1 Feb. - 31 Mar. 1973

Monem Abdel-Gawad, Principal Investigator 9 Apr. 1973 3 p (Contract NAS5-21767) (E73-10446; NASA-CR-131241) Avail: NTIS HC \$3.00 CSCL 08E

The author has identified the following significant results. The spatial relation of mercury deposits and faults in California

coast ranges suggests regional structural control whereby the transverse faults and associated zones of weakness provided easy conduits for the ascent of hydrothermal solutions and emplacement of mercury ore. If proved valid, this relation identifies transverse fault zones as favorable structural guides for mercury exploration.

N73-20416* New York State Museum and Science Service, Albany.

TO EVALUATE ERTS-1 DATA FOR THE USEFULNESS AS A GEOLOGICAL SENSOR IN THE DIVERSE GEOLOGICAL TERRANES OF NEW YORK STATE Progress Report, period ending 15 Apr. 1973

Yngvar W. Isachsen, Principal Investigator 15 Apr. 1973 11 p (Contract NAS5-21784)

(E73-10457; NASA-CR-131257) Avail: NTIS HC \$3.00 CSCI 08G

The author has identified the following significant results. The straight NNE-trending escarpment that marks the easternmost extent of the Catskill Mountains appears, from ERTS-1 imagery (1079-15124) to be related to a set of parallel topographic lineaments which occur over a distance of 40 km to the west. The October 11 imagery of the Adirondacks (1080-15174) displays the pre-Paleozoic erosion surface along the western and northern margin of the Adirondack Mountains dome. The northern portion of this paleoplain is terminated to the southeast by an escarpment following an ENE topographic linear to produce a pseudo-cuesta. The snow covered terrain in the Mohawk Valley between Albany and Rome (1170-15182 and 1169-15123) displays with sculptural clarity a drumlin field having a cloud-free area of about 2800 sq km; glacial flow directions can be plotted readily because the stoss and lee sides of the drumlins can be distinguished. In the imagery of summer and fall, agricultural patterns obscured the detail which is visible in the winter imagery.

N73-20456* Agency for International Development, Washington, D.C. Office of Science and Technology.

THE APPLICATION OF GEOCHEMICAL, BOTANICAL, GEOPHYSICAL, AND REMOTE SENSING MINERAL PROSPECTING TECHNIQUES TO TROPICAL AREAS (STATE OF THE ART AND RESEARCH PRIORITIES)

Nov. 1972 81 p refs

(PB-213230; TA/OST-72-13) Avail: NTIS HC \$3.00 CSCI 08I

Both conventional and emerging new technologies for mineral prospecting are treated under the following major topical headings: geochemical prospecting, botanical prospecting, geophysical prospecting, and remote sensing. In addition to providing brief descriptions of various instruments and survey methodologies and their principal applications, approximate costs for basic instrumentation as well as for particular types of surveys have been estimated. Each section concludes with an identification of on-going research activities, research gaps, and priorities with respect to future research. Author (GRA)

N73-21315* Stanford Univ., Calif. School of Earth Sciences. **STRUCTURAL AND LITHOLOGIC STUDY OF NORTHERN COAST RANGES AND SACRAMENTO VALLEY, CALIFORNIA** Progress Report

Ernest I. Rich, Principal Investigator 1 Mar. 1973 4 p ERTS (Contract NAS5-21775)

(E73-10478; NASA-CR-131283) Avail: NTIS HC \$3.00 CSCI 08F

The author has identified the following significant results. Analysis of ERTS-1 imagery of the Northern California Coast Ranges has disclosed a potential relation between a heretofore unrecognized fracture system and known deposits of mercury and geothermally active areas in the Coast Range and between oil and gas fields in the Sacramento Valley. Three potentially important systems of linear elements within the Coast Ranges, detected on ERTS-1 imagery, may represent fault systems or zones of shearing because topographic offset and stratigraphic disruption can be seen along one or two of the lineations. One of the systems is subparallel to the San Andreas fault and is confined to the Pacific Coastal Belt. Another set is confined to

the central core of the Coast Ranges. The third set of linear features (Valley System) has not heretofore been recognized. Some of the known mercury deposits and geothermally active areas near Clear Lake, in the Coast Ranges, are along the Valley System or at the intersection of the Central and Valley Systems. The plotted locations of some of the oil and gas fields in the Sacramento Valley are associated with the Valley and/or Central Systems. If these relations prove reliable, the ERTS-1 imagery may prove to be an extremely useful exploration tool. A.L.

N73-21331* Geological Survey, Menlo Park, Calif.

REMOTE SENSING OF PERMAFROST AND GEOLOGICAL HAZARDS IN ALASKA Progress Report, 1 Jan. - 28 Feb. 1973

Oscar J. Ferrians, Jr., Principal Investigator 1 Mar. 1973 3 p ERTS

(NASA Order S-70243-AG-2)

(E73-10495; NASA-CR-131315) Avail: NTIS HC \$3.00 CSCI 08G

The author has identified the following significant results. The study of the ERTS-1 imagery of Alaska indicates the following: that areas of different topographic expression affecting the distribution and character of permafrost can be distinguished clearly; that on the Arctic North Slope, regional differences in the distribution and character of permafrost-related oriented thaw lakes can be observed; that the distribution of certain types of geologic materials having a significant effect on the character of permafrost can be delineated on a regional scale; and that the resolution of the imagery is adequate to identify large scale geologic hazards such as landslides, glacier-dammed lakes, aufeis fields, etc. The information concerning the distribution and character of permafrost and geologic hazards to be gained in accomplishing the objectives of this project will be an invaluable aid in solving engineering-geologic and environmental problems related to route and site selection for structures such as roads, railroads, pipelines, and large installations; to distribution of natural construction materials; and to construction and maintenance.

N73-21332* Geological Survey, Menlo Park, Calif.

IDENTIFICATION OF GEOSTRUCTURES OF CONTINENTAL CRUST PARTICULARLY AS THEY RELATE TO MINERAL RESOURCE EVALUATION Progress Report, 1 Jan. - 28 Feb. 1973

George Gryc, Principal Investigator and Ernest H. Lathram 1 Apr. 1973 5 p refs ERTS

(NASA Order S-70243-AG-1)

(E73-10496; NASA-CR-131316) Avail: NTIS HC \$3.00 CSCI 08G

N73-22276* Johns Hopkins Univ., Baltimore, Md. Maryland Geological Survey.

SURVEY OF GEOLOGY, MINERAL, AND WATER RESOURCES Progress Report

Kenneth N. Weaver, Principal Investigator 8 May 1973 6 p ERTS

(Contract NAS5-21848)

(E73-10433; NASA-CR-131223) Avail: NTIS HC \$3.00 CSCI 08G

N73-22285* Utah Univ., Salt Lake City. Dept. of Geological and Geophysical Sciences.

MINERAL EXPLORATION AND FRACTURE TRENDS IN UTAH AND NEVADA, BY ERTS-1 IMAGERY Progress Report

Mead L. Jensen, Principal Investigator and M. Smith 24 Apr. 1973 7 p ERTS

(Contract NAS5-21883)

(E73-10510; NASA-CR-131620) Avail: NTIS HC \$3.00 CSCI 08G

The author has identified the following significant results. Major structural trends have been compiled on five separate maps, at a scale of 1:1,000,000, of Utah and Nevada from ERTS-1 imagery. An arbitrary length of ten kilometers has been chosen as a minimum length of the trends. The selection is based upon: (1) obvious displacement of structures; (2) continuity or persistence of trends across structures; (3) line-up of outcrop

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patterns, drainage, erosional features or vegetation; and (4) near-linear trends. Several recognizable trend directions were noted, viz., N 10-15 deg W, N 35 deg W, N 80 deg W, N 30 deg E, and E-W. More than 1500 structural trends have been identified, some of which are mineralized and extend into pediment or shallow alluvial cover. Those fracture trends that exhibit mineralization in exposed bedrock will be assayed for mercury content with a soil-gas analyzer, and similar collection will be done over alluvial posture blankets by the same technique with the hope of discovering blind mineralized zones that are not exposed on the surface.

N73-22293* Kennecott Exploration, Inc., Salt Lake City, Utah. Exploration Services Dept.

RECOGNITION OF THE GEOLOGIC FRAMEWORK OF PORPHYRY COPPER DEPOSITS ON ERTS-1 IMAGERY

Progress Report
John C. Wilson, Principal Investigator 8 May 1973 3 p ERTS (Contract NAS5-21769)
(E73-10526; NASA-CR-131499) Avail: NTIS HC \$3.00 CSCL 08G

N73-22299* Geological Survey, Washington, D.C.
GEOLOGICAL AND GEOPHYSICAL REMOTE SENSING OF ICELAND Progress Report, 15 Jan. - 30 Apr. 1973

Richard S. Williams, Jr., Principal Investigator 1 May 1973 8 p refs Sponsored by NASA ERTS
(E73-10535; NASA-CR-131611) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. A binational, multidisciplinary research effort in Iceland is directed at an analysis of MSS imagery from ERTS-1 to study a variety of geologic, hydrologic, oceanographic, and agricultural phenomena. Initial findings are: (1) recent lava flows can be delineated from older ones; (2) ERTS-1 and NOAA-2 recorded volcanic eruptions on Heimaey, Vestmann Islands; (3) coastline changes are mappable; (4) areas covered with new or residual snow can be mapped, and dark appearance of newly fallen snow on band 7 appears to be related to melting; (5) sediment plumes from discharge of glacial rivers can be delineated; (6) the area encompassed by glacial ice can be mapped, including the new position of a surging glacier, Eyjabakkajökull, and related phenomena of nunataks and moraines; (7) changes in position of rivers, lake sizes, and new lakes can be mapped; (8) low sun angle imagery enhances the morphologic expression of constructional glacial and volcanic landforms; (9) MSS color composites permit regional mapping of distribution of vegetation; and (10) at least at 1:250,000 map scale and smaller, ERTS-1 imagery provides a means of updating various types of maps of Iceland and will permit the compilation of maps specifically aimed at those dynamic environmental phenomena which impact on the Icelandic economy.

N73-22308* Martin Marietta Corp., Denver, Colo.
MINERAL RESOURCES LOCATED BY REMOTE SENSING: LIMESTONE, COPPER, MOLYBDENUM
Mar. 1973 56 p Original contains color illustrations (MCR-73-62) Avail: NTIS HC \$5.00

The application of remote sensing technology to commercial mining activities is discussed. Both investigations were in the field of mineral exploration, but were conducted under greatly different conditions of vegetation cover, requiring two different technological approaches. The prime technique was the description and analysis of surface morphology to include topography, drainage, surface geology, soils, gravels, and vegetation. Analysis of the remotely sensed data was confirmed by drilling, geochemistry, and ore grade mineralization. Author

N73-22346* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
RECOGNITION OF SURFACE LITHOLOGIC AND TOPOGRAPHIC PATTERNS IN SOUTHWEST COLORADO WITH ADP TECHNIQUES

William N. Melhorn and Scott Sinnock 1973 9 p refs (Grant NGL-15-005-112)

(NASA-CR-131577; LARS-030273) Avail: NTIS HC \$3.00 CSCL 08B

Analysis of ERTS-1 multispectral data by automatic pattern recognition procedures is applicable toward grappling with current and future resource stresses by providing a means for refining existing geologic maps. The procedures used in the current analysis already yield encouraging results toward the eventual machine recognition of extensive surface lithologic and topographic patterns. Automatic mapping of a series of hogbacks, strike valleys, and alluvial surfaces along the northwest flank of the San Juan Basin in Colorado can be obtained by minimal man-machine interaction. The determination of causes for separable spectral signatures is dependent upon extensive correlation of micro- and macro-field-based ground truth observations and aircraft underflight data with the satellite data. Author

N73-22384 George Washington Univ., Washington, D.C.
THE FEASIBILITY OF DETECTING SUBSURFACE COAL FIRES IN WYOMING AND MONTANA FROM THE GROUND, ON AERIAL PHOTOGRAPHY AND ON SATELLITE IMAGERY Ph.D. Thesis

George A. Rabchevsky 1972 423 p
Avail: Univ. Microfilms Order No. 72-25062

An investigation was made to determine the usefulness of ground, aircraft and satellite remote sensing methods for the detection of surface and subsurface coal fires burning in north central Wyoming and southern Montana. Field studies were conducted during the spring, summer and fall seasons and used as back-up information for the analysis of available satellite imagery and aerial multispectral photography, provided by the U.S. Bureau of Mines. Ground observations were the most effective and reliable method for the detection of coal fires. Usefulness of the available aerial fall-season multispectral photography was marginal and the examination of the existing satellite imagery, applicable for the detection of coal fires on the ground, was the least productive. Suggestions and recommendations are presented for future more effective photographic aircraft missions and potential satellite programs. Finally, the various existing methods for the detection of coal fires are summarized in a tabular form and their effectiveness compared. Dissert. Abstr.

N73-23411* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
STRUCTURAL FEATURES IN THE COLORADO PLATEAU MARGIN NEAR FLAGSTAFF, ARIZONA

Alexander F. H. Goetz, Principal Investigator and Donald P. Elston (Geol. Surv., Flagstaff, Ariz.) [1973] 1 p Sponsored by NASA ERTS
(E73-10517; NASA-CR-131478) Avail: NTIS HC \$3.00 CSCL 08E

The author has identified the following significant results. On ERTS-1 frame 1014-17375, a set of northwest-trending lineaments has been discovered which converge on the north-trending lineament of the Oak Creek Fault near Flagstaff, Arizona. The lineaments are most easily seen in band 7. The region of convergence may mark an area structurally favorable for the location of water in Paleozoic sediments that underlie the basalt cap.

N73-23414* Texas Instruments, Inc., Dallas.
EVALUATION OF COMMERCIAL UTILITY OF ERTS-A IMAGERY IN STRUCTURAL RECONNAISSANCE FOR MINERALS AND PETROLEUM Progress Report, 1 Mar. - 30 Apr. 1973

Donald F. Saunders, Principal Investigator 8 May 1973 4 p ERTS
(Contract NAS5-21796)
(E73-10523; NASA-CR-131490) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. The only area that has been analyzed to date is Area 3 where results have already been reported. However, work progressing in Area 1 and 2 seem to indicate a good correlation between lineament zones previously reported, mineralized areas and lineaments currently being picked from ERTS-1 imagery. There also appear to be many lineaments on ERTS-1 imagery in these areas which have not been reported in any other literature.

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N73-23416* Argus Exploration Co., Newport Beach, Calif.
A RECONNAISSANCE SPACE SENSING INVESTIGATION OF CRUSTAL STRUCTURE FOR A STRIP FROM THE EASTERN SIERRA NEVADA TO THE COLORADO PLATEAU Progress Report, 1 Mar. - 30 Apr. 1973

Ira C. Bechtold, Principal Investigator 11 May 1973 10 p ERTS
(Contract NAS5-21809)
(E73-10529; NASA-CR-131594) Avail: NTIS HC \$3.00 CSCL 08G

N73-23420* Geological Survey, Menlo Park, Calif.
INVESTIGATION OF PROTOTYPE VOLCANO SURVEILLANCE NETWORK Progress Report, 1 Jan. - 28 Feb. 1973

Jerry P. Eaton, Principal Investigator and Peter L. Ward 1 Mar. 1973 4 p ERTS
(NASA Order S-70243-AG-2)
(E73-10545; NASA-CR-131649) Avail: NTIS HC \$3.00 CSCL 08E

The author has identified the following significant results. Earthquake counters in Guatemala were being installed between February 13 and 17. The volcano Fuego began erupting ash and ash flows on February 23. On February 17, 6 days before the eruption there were 80 earthquakes at two counters 5 and 15 km from the volcano. This was a substantial increase of a fairly constant level of events per day recorded for the previous four days. A counter 30 km away did not show an increase. Had the DCP been operating longer and had the data been sent immediately from Goddard, it might have been possible to warn of a possible eruption six days in advance.

N73-23424* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

AN INTERDISCIPLINARY ANALYSIS OF ERTS DATA FOR COLORADO MOUNTAIN ENVIRONMENTS USING ADP TECHNIQUES Bimonthly Progress Report, 1 Mar. - 30 Apr. 1973

Roger M. Hoffer, Principal Investigator 30 Apr. 1973 11 p ERTS
(Contract NAS5-21880)
(E73-10551; NASA-CR-131850) Avail: NTIS HC \$3.00 CSCL 08F

N73-23427* Geological Survey, Washington, D.C.
IRON-ABSORPTION BAND ANALYSIS FOR THE DISCRIMINATION OF IRON-RICH ZONES Progress Report, 1 Jan. - 28 Feb. 1973

Lawrence C. Rowan, Principal Investigator 26 Apr. 1973 4 p ERTS
(NASA Order S-70243-AG-4)
(E73-10555; NASA-CR-131854) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. Lineament analysis of the area was initiated on individual images and then expanded areally by the use of mosaics at the 1:1,000,000 scale. Principal trends are NE, NW, NNE-NNW, and ENE. Several previously unrecognized lineaments are mapped which may be the surface manifestations of major fault or fracture zones. Three lineaments are especially noteworthy. Two of these, the Walker Lane and the Midas Trench lineament system, transect the predominantly NNE-NNW trending mountain ranges for more than 500 km. A third major lineament, formed by the alignment of several topographic escarpments 10-20 km long, is orthogonal to the Midas Trench lineament. This lineament is marked by a distinct positive magnetic anomaly for approximately 200 km. Further visual analysis of ERTS-1 images has resulted in the delineation of 50 circular or elliptical features which are presumed to be volcanic or intrusive centers. A comparison with the 78 Tertiary volcanic centers mapped in the study area in 1970 indicates some good agreement between the proposed and known volcanic centers. The coincidence of some major lineaments and productive ore bodies implies a genetic relationship.

N73-23428* Geological Survey, Washington, D.C.
THERMAL SURVEILLANCE OF ACTIVE VOLCANOES Progress Report, 1 Feb. - 31 Mar. 1973

Jules D. Friedman, Principal Investigator 1 Apr. 1973 3 p ERTS
(NASA Order S-70243-AG)
(E73-10556; NASA-CR-131855) Avail: NTIS HC \$3.00 CSCL 08E

N73-23430* Geological Survey, Menlo Park, Calif.
INVESTIGATION OF PROTOTYPE VOLCANO SURVEILLANCE Progress Report, 1 Mar. - 30 Apr. 1973

Jerry P. Eaton, Principal Investigator and Peter L. Ward 1 May 1973 3 p ERTS
(NASA Order S-70243-AG-2)
(E73-10558; NASA-CR-131857) Avail: NTIS HC \$3.00 CSCL 08E

N73-23436* Wyoming Univ., Laramie. Remote Sensing Lab.
ERTS-1 STUDY OF THE GEOLOGY OF THE ICE-FREE VALLEYS OF ANTARCTICA Progress Report, Mar. - Apr. 1973

Frank Zochol and R. W. Marrs 1 May 1973 6 p refs ERTS
(Contract NAS5-21818)
(E73-10564; NASA-CR-131863; ERTS-ANT-1-738) Avail: NTIS HC \$3.00 CSCL 08G

N73-23438* Stanford Univ., Calif. School of Earth Sciences.
STRUCTURAL AND LITHOLOGIC STUDY OF NORTHERN COAST RANGES AND SACRAMENTO VALLEY, CALIFORNIA Progress Report

Ernest I. Rich, Principal Investigator 1 May 1973 2 p ERTS
(Contract NAS5-21775)
(E73-10577; NASA-CR-131881) Avail: NTIS HC \$3.00 CSCL 08E

N73-23443* Iowa Univ., Iowa City.
UTILIZING ERTS-A IMAGERY FOR TECTONIC ANALYSIS THROUGH STUDY OF BIG HORN MOUNTAINS REGION Progress Report, 16 Mar. - 15 May 1973

Richard A. Hoppin, Principal Investigator 15 May 1973 3 p ERTS
(Contract NAS5-21852)
(E73-10583; NASA-CR-131899) Avail: NTIS HC \$3.00 CSCL 08E

The author has identified the following significant results. NASA-provided color composite (1048-17234) which includes the southeastern portion of the Bighorn Mountains and the western Powder River basin is of excellent quality. The considerable variations in the red hues indicate that vegetational mapping will be enhanced over the black and white. Some additional delineation of rock units can be made, particularly the Chugwater formation. Preliminary look at just received winter scenes indicates that topographic features are enhanced both due to the snow cover and to the lower sun angle.

N73-23444* International Inst. for Aerial Survey and Earth Sciences, Enschede (Netherlands).
EVALUATION OF THE POTENTIALS OF THE ERTS TECHNIQUES FOR GEOLOGICAL MAPPING PURPOSES Progress Report, Mar. - May 1973

H. E. C. VandeMeer Mohr, Principal Investigator May 1973 5 p Sponsored by NASA ERTS
(E73-10584; NASA-CR-131900) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. Preliminary analysis of the full frame images shows the following: (1) The techniques employed were found suitable for study purposes. (2) The positional accuracy of the system corrected bulk processed MSS images is about 100-400 m. (3) Drainage is well depicted and morphotectonic features could be recognized. (4) Water bodies are clearly shown in MSS band 7. (5) Major roads, railway lines, and large towns are more or less detectable on bands 6 and 7. (6) Vegetation and agricultural areas are recognizable at many places. (7) Major rock formation boundaries.

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in general, are more or less clear. (8) Some of the structural trends including folded and linear structural elements are clear. (9) MSS bands 5 and 7 appear to be most useful for visual analysis. (10) Quick look analysis suggests that regional geological mapping on ERTS-1 imagery of the study area will be probably quite feasible. However, detailed analysis, visual and quantitative, on subframes, which is under progress may render more significant results.

N73-23448* New Mexico State Bureau of Mines and Mineral Resources, Socorro.

GEOLOGIC ANALYSIS AND EVALUATION OF ERTS-A IMAGERY FOR THE STATE OF NEW MEXICO Progress Report, 15 Mar. - 14 May 1973

Frank E. Kottlowski, Principal Investigator 14 May 1973 2 p ERTS

(Contract NAS5-21861)

(E73-10588; NASA-CR-131904) Avail: NTIS HC \$3.00 CSCL 08G

N73-23450* Earth Satellite Corp., Berkeley, Calif.

MINERAL EXPLORATION POTENTIAL OF ERTS-1 DATA Progress Report, Dec. - May 1973

W. A. Brewer, Principal Investigator, M. C. Erskine, Jr., and R. O. Prindle 18 May 1973 7 p ref ERTS

(Contract NAS5-21745)

(E73-10591; NASA-CR-131907) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. Further analysis of ERTS-1 MSS imagery of Arizona has led to division of the earlier reported three major regional fault/fracture systems into eight subdivisions. These are: System A - N40E to N50E; System B - N50W; System C - N35W; System D - N65E to N75E; System E - N-E; System F - N25W average; System G - N75W average; and System H - close to E-W. Their individual significance to known porphyry coppers and correlation to the Wasatch-Jerome and Front Orogens, the Texas Zone and Basin Range topography is postulated in the report. In this study area of Arizona the ERTS-1 mapped structural trends confirm and greatly extend some concepts of porphyry copper distribution based on prior geologic knowledge of major structural trends.

N73-23474* Maritime Safety Agency, Tokyo (Japan).

DATA REPORT OF HYDROGRAPHIC OBSERVATIONS. SERIES OF MAGNETIC SURVEY, NO. 2: MAGNETIC SURVEY OF JAPAN, 1969 - 1970

Mar. 1973 224 p

(Pub-592) Avail: NTIS HC \$13.25

Results are presented of a geomagnetic survey conducted in and around Japan from July 1969 until November 1970. The special magnetometric equipment employed on board the YS-11 aircraft is described by means of specifications and photographs. The data appear in the form of seven types of magnetic charts, in addition to tables which specify times and dates of the observed geomagnetic values. J.M.M.

N73-23475* Maritime Safety Agency, Tokyo (Japan).

DATA REPORT OF HYDROGRAPHIC OBSERVATIONS. SERIES OF GEOMAGNETISM, NO. 7: THE RESULTS OF MAGNETIC OBSERVATIONS FOR THE YEAR 1967 - 1969

Feb. 1973 292 p

(Pub-591) Avail: NTIS HC \$16.75

Report is made of magnetic observations made at the Simosato Magnetic Observatory from 1967 to 1969. The results, which appear in tabular and graphic form, include special magnetic data compiled during post-IQSY and IASY. J.M.M.

N73-24355* Environmental Research Inst. of Michigan, Ann Arbor.

AN ERTS EXPERIMENT FOR MAPPING IRON COMPOUNDS R. K. Vincent, Principal Investigator In its ERTS-1 Invest. conducted by Environ. Res. Inst. of Mich. 9 May 1973 1 p ERTS

(E73-10575) CSCL 08B

N73-24362* Geological Survey, Menlo Park, Calif.

REMOTE SENSING OF PERMAFROST AND GEOLOGIC HAZARDS IN ALASKA Progress Report, 1 Mar. - 30 Apr. 1973

Oscar J. Ferrians, Jr., Principal Investigator 1 May 1973 3 p ERTS

(NASA Order S-70243-AG-2)

(E73-10601; NASA-CR-131997) Avail: NTIS HC \$3.00 CSCL 08L

N73-24369* Colorado School of Mines, Golden. Dept. of Geology.

GEOLOGIC AND MINERAL AND WATER RESOURCES INVESTIGATIONS IN WESTERN COLORADO USING ERTS-1 DATA Progress Report, Dec. 1972 - May 1973

Daniel H. Knepper, comp. May 1973 31 p refs ERTS

(Contract NAS5-21778)

(E73-10608; NASA-CR-132005; PR-6) Avail: NTIS HC \$3.75 CSCL 08G

The author has identified the following significant results. Geologic interpretation of ERTS-1 imagery is dependent on recognition of the distribution, continuity, trend, and geometry of key surface features. In the examination of ERTS-1 imagery, lithology must be interpreted largely from the geomorphic expression of the terrain. ERTS-1 imagery is extremely useful in detecting local structures. Most mapped structures are topographically-expressed. Consequently, ERTS-1 imagery acquired during mid-winter, when the solar illumination angle is low, provides the largest amount of structural information. Stereoscopic analyses of ERTS-1 images significantly aid geologic interpretation. Positive transparencies of ERTS-1 images (1:1,000,000) commonly contain more geologic information than can be adequately annotated during geologic interpretation.

N73-24376* Servicio Geologico de Bolivia, La Paz.

APPLICATION OF ERTS IMAGERY TO GEOLOGICAL MAPPING [APLICACION DE IMAGENES ERTS ALMAPEO GEOLOGICO]

Alvaro Fernandez, Oscar Aranibar, and Paul Ballon 1973 18 p In SPANISH Sponsored by NASA Original contains imagery.

Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (E73-10614; NASA-CR-132011) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. In comparing the interpretation of the imagery with that of photomosaics, the following results were derived. The drainage networks of the RBV images show information in greater detail than the photomosaics, and maps, yet maintain scale differences. However, for the basins the mosaics and maps provide better information. The geomorphology is best interpreted in the images of the ERTS-1, not only for the regional countryside, but also for the morphological formations. It was concluded that the satellite images offer the better possibility for identifying the alignment of joints and faults. In the images the relation is 4 to 1. The considered N-S alignments were identified in both systems with a ratio of 2 to 1. The E-W alignments for the areas considered in the ERTS-1 images show a basic Paleozoic formation not previously detected. Transl. by F.O.S.

N73-24377* Alaska Univ., Fairbanks.

EVALUATION OF FEASIBILITY OF MAPPING SEISMICALLY ACTIVE FAULTS IN ALASKA Bimonthly Progress Report Larry Gedney, Principal Investigator 31 May 1973 3 p refs ERTS

(Contract NAS5-21833)

(E73-10616; NASA-CR-132027; BMPR-5) Avail: NTIS HC \$3.00 CSCL 08B

N73-24383* Smithsonian Astrophysical Observatory, Cambridge, Mass.

MAPPING OF THE MAJOR STRUCTURES OF THE AFRICAN RIFT SYSTEM Progress Report, 1 Mar. - 30 Apr. 1973

Paul Mohr, Principal Investigator 30 Apr. 1973 5 p ERTS (Contract NAS5-21748)

(E73-10622; NASA-CR-132033) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. ERTS-1 imagery of the African rift system has already proved of great value in structural geological studies. One of the interesting megastructures expressed on the imagery occurs some 40 km east of the eastern margin of the main Ethiopian rift, in Arussi province, and extending between latitude $71/2$ and $81/4$ deg N. The Badda-Encuolo ridge proves to have been a line of major Tertiary volcanism and probably supplied the thick Trap Series flood basalt sequence exposed farther east in the canyons of the Webi Shebeli drainage system. The ridge itself was built up by the waning activity of the Sagatu line of volcanism. Serendipitous has been the discovery on Mt. Badda of several deeply glaciated valleys, many of which show clearly on the ERTS-1 imagery. It seems that Mt. Badda was one of the most important glacial centers in eastern Africa during the Pleistocene. Three major late-Tertiary trachytic centers lie between the Badda-Encuolo ridge and the rift valley. The relationships of these three volcanoes to each other and to the rift faulting is revealed for the first time by the ERTS-1 imagery, as is the form of the cladera of Baltata and the crater of Chilalo.

N73-24432# Bureau of Mines, Denver, Colo.

SATELLITE MONITORING OF OPEN PIT MINING OPERATIONS

William C. Henkes 1971 32 p

(BM-IC-8530) Avail: SOD \$0.35

The relationships between areal extent, development, volume of waste dumps, and the pits of open pit mining operations as observed on the ground and on photographs taken from satellites are investigated. The ultimate goal is the establishment of criteria to evaluate repetitive space imagery in quantifiable terms. These criteria would aid the Bureau of Mines in discharging its responsibilities in the fields of solid waste disposal, reclamation of mine workings, and mineral resources inventory. The study serves as a basis for additional experiments using remote sensing techniques in the minerals industry. Author

N73-24433*# Colorado School of Mines, Golden. Dept. of Geology.

APPLICATION OF REMOTE SENSOR DATA TO GEOLOGIC ANALYSIS OF THE BONANZA TEST SITE COLORADO

Semiannual Progress Report, 1 Oct. 1972 - 31 Mar. 1973

Keenan Lee, comp. Apr. 1973 55 p refs

(Grant NGL-06-001-015)
(NASA-CR-132231; Rept-73-2) Avail: NTIS HC \$4.75 CSCL 08G

A geologic map of the Bonanza Test Site is nearing completion. Using published large scale geologic maps from various sources, the geology of the area is being compiled on a base scaled at 1:250,000. Sources of previously published geologic mapping include: (1) USGS Bulletins; (2) professional papers and geologic quadrangle maps; (3) Bureau of Mines reports; (4) Colorado School of Mines quarterlies; and (5) Rocky Mountain Association of Geologist Guidebooks. This compilation will be used to evaluate ERTS, Skylab, and remote sensing underflight data. Author

N73-25333 Colorado State Univ., Fort Collins.

EARTH DYNAMIC FILTERING FOR EARTHQUAKE PREDICTION AND LOVE NUMBER DETERMINATION Ph.D. Thesis

Paul Frederick McClure 1972 163 p

Avail: Univ. Microfilms Order No. 72-31333

A discrete time extended Kalman filtering algorithm was developed for processing geodetic data. The method includes differential equations describing the rotational motion of a deformable earth as part of the model of the system that generates the observations. By including the earth dynamical relationships it is possible to determine the coordinates of the rotation pole as dynamical variables rather than as fixed parameters and to obtain an estimate for the position of the secular pole. Range observations are simulated with a 2 cm noise level between a geodetic satellite and a global network of ground stations. By responding to changes in the position of the secular pole, the method provides a new means for testing the hypothesis that major earthquakes correspond to detectable breaks in the path

of the rotation pole and that the pole path may shift slightly prior to an earthquake as strain accumulates within large sections of the crust. Dissert. Abstr.

N73-25337*# Maryland Geological Survey, Baltimore.

DIFFERENTIATION OF SERPENTINITIC FROM NONSERPENTINITIC ULTRAMAFIC ROCKS IN ERTS-1 MSS IMAGERY

William Crowley and Kenneth N. Weaver, Principal Investigator 27 Jun. 1973 2 p ERTS

(Contract NAS5-21848)

(E73-10632; NASA-CR-132198) Avail: NTIS HC \$3.00 CSCL 08G

N73-25342*# Eason Oil Co., Oklahoma City, Okla.

AN EVALUATION OF THE SUITABILITY OF ERTS DATA FOR THE PURPOSES OF PETROLEUM EXPLORATION Interim Report, Dec. 1972 - May 1973

Robert J. Collins, Principal Investigator, F. P. McCown, L. P. Stonis, and Gerald Petzel Jun. 1973 18 p ERTS

(Contract NAS5-21735)

(E73-10646; NASA-CR-132980) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. ERTS-1 imagery seems to be good to excellent for reconnaissance level investigations of large sedimentary basins such as the Anadarko Basin. Many lithologic boundaries, and geomorphic features, and linear features inferred to be indicative of geologic structure are visible in the imagery. This imagery in conjunction with high altitude photography seems to be useful as a tool for intermediate level geologic exploration. Several types of crudely circular anomalous features, such as geomorphic/structural anomalies, hazy areas and tonal anomalies, are identifiable in the imagery. There seems to be a strong correlation between the geomorphic/structural and hazy anomalies and known structurally controlled oil and gas fields. The features recognizable on ERTS-1 imagery and their ease of recognition vary from area to area even in imagery acquired at the same time under essentially uniform atmospheric conditions. Repeated coverage is exceedingly valuable in geologic applications. One time complete coverage even for the various seasons does not reveal all the features that ERTS-1 can reveal.

N73-25344*# Geological Survey, Washington, D.C.

GEOLOGIC MAPPING AND MINERAL RESOURCE INVENTORY BY ERTS-1 SATELLITE DATA IN SOUTH AMERICA Progress Report, 15 Jan. - 30 Apr. 1973

William D. Carter, Principal Investigator 1 May 1973 6 p

refs Sponsored by NASA ERTS

(E73-10648; NASA-CR-132239) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. ERTS-1 data clearly provide significant contribution of new information on the remote areas of South America. Salar deposits have been measured and compared with those shown on World Navigation Charts; remarkable differences have been found in shape, size, number, and distribution. Repetitive coverage should enable us to develop an index of seasonal and annual environmental trends that can be compared with those of the Northern Hemisphere. New lineations, many of which are probably faults, have been found in Venezuela, Bolivia, and northern Argentina. Circular features, some of volcanic origin, have been recognized that are not shown on existing maps. The courses of several rivers have been revised and our Venezuelan counterparts report that a major new river has been recognized and charted. Large mining operations, such as the open pit copper mine of Chuquicamata in northern Chile, are recognizable and can be studied in their regional context.

N73-25352*# Bureau de Recherches Geologiques et Minieres, Orleans (France).

CAPABILITY OF ERTS-1 IMAGERY TO INVESTIGATE GEOLOGICAL AND STRUCTURAL FEATURES IN A SEDIMENTARY BASIN (BASSIN PARISIEN, FRANCE)

Guy Weecksteen, Principal Investigator, C. Cavalier, J. Y. Scanvic,

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and A. Zizerman [1973] 2 p Sponsored by NASA ERTS (E73-10656; NASA-CR-132247) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. The region covered by the MSS images has the benefit of complete geological mapping at scales of 1:80,000, 1:320,000, and 1:1,000,000. Comparison of imagery and existing geological maps, particularly the 1:1,000,000 scale, produces important information: (1) Good correspondence is seen between large units distinguished on the images and the concentric strata of the Jurassic, Cretaceous, and Paleocene on the map. (2) Comparison of MSS images with the hydrogeological map of the Parisian basin at 1:500,000 removes all ambiguity with regard to lithological variations. Among the many faults revealed, only three were considered: (1) the Metz; (2) Juranze; and (3) the double fault of the Marne. Imagery shows a conspicuous alignment of the Metz fault unknown until now and ending near Montereau against the group of north-south faults between Montargis and Bourbon l'Archambault. MSS images show that the Juranze fault divides beyond Brienne into two branches of equal importance. The northern one represents the known fault, the southern one was not known until now, but the convergence of the faults constitutes a tectonic trap. The double fault of the Marne is known for a total length of 50 km. ERTS-1 imagery suggest a prolongation toward the southeast which could bring its length to 110 km.

N73-25353*# Bureau de Recherches Geologiques et Minieres, Orleans (France).

STRUCTURAL GEOLOGY INVESTIGATION ON MASSIF CENTRAL AND PARISIAN BASIN (FRANCE)

Guy Wecksteen, Principal Investigator [1973] 2 p Sponsored by NASA ERTS (E73-10657; NASA-CR-132248) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. Band 5 gives the most information concerning the fracturing in the Massif Central and Parisian Basins. Band 6 and 7 show the fractures emphasized by forest boundaries and by the linear trace of water courses. The most remarkable information drawn from the preliminary investigation of two ERTS-1 images covering two different landscapes, a regular relief of shelving plateau bounded by cuestas having a sedimentary origin and a mountainous region built in crystalline and volcanic rocks, is that the deep structural elements under a thick sedimentary cover can be translated on the surface by indirect criteria. MSS imagery has permitted the Metz fault to be extended towards the west and shows clearly, through land use on the Rhone Valley fluvial deposit, the continuation towards the east of the carboniferous basin of St. Etienne

N73-25359*#, Wyoming Univ., Laramie. Remote Sensing Lab. ANALYSIS OF PHOTO LINEAR ELEMENTS, LARAMIE MOUNTAINS, WYOMING

Donald L. Blackstone, Jr. 1 Jun. 1973 16 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21779) (E73-10663; NASA-CR-132172; ERTS-1-S73-3) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. Photo linear features in the Precambrian rocks of the Laramie Mountains are delineated, and the azimuths plotted on rose diagrams. Three strike directions are dominant, two of which are in the northeast quadrant. Laramide folds in the Laramie basin to the west of the mountains appear to have the same trend, and apparently have been controlled by response of the basement along fractures such as have been measured from the imagery.

N73-25360*# Alaska Univ., Fairbanks. GLACIOLOGICAL AND VOLCANOLOGICAL STUDIES IN THE WRANGELL MOUNTAINS, ALASKA Bimonthly Progress Report

Carl S. Benson, Principal Investigator 31 May 1973 5 p Original

contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21833)

(E73-10665; NASA-CR-132176; BMPR-5) Avail: NTIS HC \$3.00 CSCL 08F

N73-25376*# Earth Satellite Corp., Washington, D.C. STUDY OF APPLICATION OF ERTS-A IMAGERY TO FRACTURE RELATED MINE SAFETY HAZARDS IN THE COAL MINING INDUSTRY Progress Report. 1 Mar. - 1 May 1973

Charles E. Wier, Frank J. Wobber, Principal Investigators, Orville R. Russell, and Roger V. Amato 9 May 1973 15 p Prepared for Ind. Geol. Surv., Bloomington ERTS

(Contract NAS5-21795)

(E73-10681; NASA-CR-132188) Avail: NTIS HC \$3.00 CSCL 08I

The author has identified the following significant results. The 70mm black and white infrared photography acquired in March 1973 at an approximate scale of 1:115,000 permits the identification of areas of mine subsidence not readily evident on other films. This is largely due to the high contrast rendition of water and land by this film and the excessive surface moisture conditions prevalent in the area at the time of photography. Subsidized areas consist of shallow depressions which have impounded water. Patterns with a regularity indicative of the room and pillar configuration used in subsurface coal mining are evident.

N73-25377*# Helsinki Univ. (Finland). Dept. of Geology. MAJOR CRUSTAL FRACTURES IN THE BALTIC SHIELD Progress Report, Jul. 1972 - Apr. 1973

Heikki V. Tuominen, Principal Investigator 15 May 1973 32 p refs Sponsored by NASA ERTS

(E73-10682; NASA-CR-132189) Avail: NTIS HC \$3.75 CSCL 08G

The author has identified the following significant results. Black and white prints and transparencies of images 1039-09315, 1039-09322, and 1040-09371 with all bands of MSS have been used for the analyses. Bands 4 and 5 reveal the major urban areas, agricultural and timbering areas, highways as well as airfields, and an open pit mine. Even the border between Norway and Finland is clearly visible. Lakes, rivers, and wet swamps were best discerned on IR bands 6 and 7. Block fields formed by frost action are best seen on bands 4 and 5. The ancient shoreline on image 1039-09322 is seen as a narrow block field on bands 4 and 5. The effects of the Quaternary ice sheet on the morphography can be seen quite well in the images. The peat bogs are best seen in band 5, but can also be traced in bands 6 and 7. Eskers, glaciofluvial deposits, and deltas are distinguishable in bands 4 and 5, but can be traced in places also in the IR bands. Fluvial deposits are seen in the image 1039-09322 in the valleys of the Tornio and Kemi Rivers. They are easily discerned in bands 4 and 5, evidently because of the cultivated fields and pasture lands. Bands 4, 5, and 6 of image 1039-09315 reveal parts of eskers and glaciofluvial deltas which are affected by eolian activity. It seems evident that ERTS-1 imagery will be a great help in mapping Quaternary features.

N73-25379*# Alaska Univ., College. Geophysical Inst. TECTONIC MAPPING IN ALASKA WITH ERTS-1 IMAGERY Interim Scientific Report

Larry Gedney, Principal Investigator and James VanWormer 25 May 1973 8 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21833)

(E73-10685; NASA-CR-132192) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. A mosaic of ERTS-1 imagery for a portion of interior Alaska covering approximately 57,000 sq km has proved to be a valuable tool in identifying structural elements previously not recognized. Mapped faults are clearly recognizable and are found to be part

of a larger system of faults and lineaments identified on the imagery. A previously unrecognized set of conjugate fractures imply regional compression in a NNW-SSE direction in agreement with known fault dislocations. Earthquakes have a marked tendency to occur at intersections of lineaments seen on the imagery.

N73-26380*# Stanford Univ., Calif. School of Earth Sciences. **STRUCTURAL AND LITHOGRAPHIC STUDY OF NORTHERN COAST RANGES AND SACRAMENTO VALLEY, CALIFORNIA** Progress Report
Ernest I. Rich, Principal Investigator 1 Jul. 1973 8 p ERTS (Contract NAS5-21775)
(E73-10898; NASA-CR-133010) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. The analysis of the ERTS data has disclosed three potentially important linear systems within the northern coast ranges and Sacramento Valley, California. A preliminary geomorphic analysis of the northern coast ranges discloses that the geomorphic characteristics of the area underlain by the Coastal system are much different from those associated with the Central system in the core of the Coast Ranges. Within the Coastal system, or Coastal belt, the drainage networks are moderately fine-textured and have moderately high density. The area associated with the Central system seems to be underlain by a heterogeneous assemblage of rock types which vary in their resistance to erosion. The boundary between the Coastal and Central geomorphic regions is poorly defined and, in a few places, the two regions can be separated only approximately.

N73-26392*# Texas Instruments, Inc., Dallas. **EVALUATION OF COMMERCIAL UTILITY OF ERTS-A IMAGERY IN STRUCTURAL RECONNAISSANCE FOR MINERALS AND PETROLEUM** Progress Report, 1 May - 30 Jun. 1973
Donald F. Saunders, Principal Investigator 9 Jul. 1973 5 p ERTS (Contract NAS5-21796)
(E73-10700; NASA-CR-133013) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. In areas 2 and 3 (Colorado and New Mexico - Texas) continuing correlations are observed between lineaments selected from the ERTS imagery and known fault and fracture zones. There continues to be a correlation between lineament intersectional areas and known mining areas. Initial contacts with mining and/or petroleum companies regarding the use of ERTS-1 imagery as an interpreted medium for guiding reconnaissance operations seems to indicate that the technology and economics will be commercially acceptable for initial investigatory investments.

N73-26393*# Utah Univ., Salt Lake City. Dept. of Geological and Geophysical Science. **FRACTURE TRENDS IDENTIFIED BY ERTS-1 IMAGERY IN UTAH AND NEVADA**
M. L. Jensen, Principal Investigator, M. Smith, and R. J. Rogers 24 Jun. 1973 123 p ERTS (Contract NAS5-21883)
(E73-10701; NASA-CR-133014) Avail: NTIS HC \$8.25 CSCL 08E

The author has identified the following significant results. Structures clearly traceable through bed rock are considered most reliable. Continuity, however, is frequently traceable through ranges and across adjoining sedimentary basins where changes in drainage, erosion pattern, soil color, or vegetation suggest that the basin sediments are extremely sensitive to underlying structures. Many large and continuous trends, too smeared by erosion to be visible on the ground or from aircraft photos, become quite evident at the scale of the ERTS-1 images. The study was made with little regard for surface geology. The trends have been retraced to separate and unidirectional sets. These are now being related to surface geology, geophysical studies, volcanic and intrusive centers, and areas of mineralization.

N73-26395*# Wyoming Univ., Laramie. Dept. of Geology. **ANALYSIS OF LINEAR PHOTO ELEMENTS, BIGHORN-PRYOR MOUNTAINS, MONTANA AND WYOMING** Special Report
D. L. Blackstone, Jr. 10 Jun. 1973 15 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (Contract NAS5-21799)
(E73-10704; NASA-CR-133017; ERTS-1-S73-3) Avail: NTIS HC \$3.00 CSCL 08B

N73-26312*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. **APPLICATION OF ERTS AND EREP IMAGES TO GEOLOGIC INVESTIGATIONS OF THE BASIN AND RANGE, COLORADO PLATEAU BOUNDARY IN NORTHWESTERN AND NORTH-CENTRAL ARIZONA** Progress Report, 15 Feb. - 15 Apr. 1973
A. F. H. Goetz, Principal Investigator, F. C. Billingsley, D. P. Elston (Geol. Surv., Flagstaff, Ariz.), I. Luccitta (Geol. Surv., Flagstaff, Ariz.), and E. M. Shoemaker (Calif. Inst. of Tech., Pasadena) 18 May 1973 4 p Sponsored by NASA ERTS (E73-10645; NASA-CR-132235) Avail: NTIS HC \$3.00 CSCL 08G

N73-26318*# National Center for Earthquake Research, Menlo Park, Calif. **INVESTIGATION OF PROTOTYPE VOLCANO-SURVEILLANCE NETWORK** Progress Report, 1 May - 30 Jun. 1973
Jerry P. Eaton, Principal Investigator and Peter L. Ward 1 Jul. 1973 9 p refs ERTS (NASA Order S-70243-AG-2)
(E73-10711; NASA-CR-133062) Avail: NTIS HC \$3.00 CSCL 08K

The author has identified the following significant results. The equipment installed in the volcano surveillance network continues to work quite reliably and earthquakes are being recorded at all sites. A summary of platform receptions per day has been prepared.

N73-26320*# Geological Survey, Washington, D.C. **SATELLITE GEOLOGICAL AND GEOPHYSICAL REMOTE SENSING OF ICELAND** Progress Report, 1 May - 30 Jun. 1973
Richard S. Williams, Jr., Principal Investigator 1 Jul. 1973 8 p ref Sponsored by NASA ERTS (E73-10713; NASA-CR-133064) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. A low sun angle (as low as 7 degrees) on ERTS-1 imagery, particularly when the terrain is snow-covered, markedly enhances subtle geologic structure and landforms. Hot springs, discharging into frozen lakes, from an ice-free area which can be easily seen on ERTS-1 imagery. In remote areas ERTS-1 imagery can be used in climatological studies by using the time of lake ice freeze-up and break-up as a measure over large areas. ERTS-1 imagery of the erupting volcano, Kirkjufell, on the island of Heimaey was cloud covered. ERTS-1 provides a powerful new tool for volcanologists to study erupting volcanoes, new deposits of lava, and the direction and areal distribution of the eruption plume. Some success was achieved in a preliminary study, using photogrammetric instrumentation, of measuring relative elevation of mountains using ERTS-1 imagery of Iceland, where considerable overlap exists in successive orbits.

N73-26329*# Iowa Univ., Iowa City. **UTILIZING ERTS-A IMAGERY FOR TECTONIC ANALYSIS THROUGH STUDY OF BIG HORN MOUNTAINS REGION** Progress Report, 16 May - 15 Jul. 1973
Richard A. Hoppin, Principal Investigator 15 Jul. 1973 2 p ERTS (Contract NAS5-21852)
(E73-10722; NASA-CR-133066) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. Winter imagery in December 6-10, 1972 and January 11-13,

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1972, provides optimum snow cover and depth such that, along with low sun angle, topography and drainage are markedly enhanced. Several features are visible that are poorly, or even not distinguishable on clear scenes without snow. Examples are Bear Butte (igneous plug) and Elkhorn Peak (dome) on scene (1136-17130), northeastern Black Hills, (1172-17130) a linear linking the Cascade anticline and Cretaceous hogbacks near Hot Springs, S. D. south to the Niobrara River, and (1140-17373) the Lake Basin fault zone north of Billings, Montana. Extremely heavy snows in April completely blot out all vegetation and topography in the Bighorn, Wind River, and Beartooth ranges.

N73-26337*# Wolf Research and Development Corp., Pocomoke City, Md.

APPLICABILITY OF SATELLITE REMOTE SENSING FOR MONITORING SURFACE MINING ACTIVITIES Quarterly Progress Report, 8 Mar. - 8 Jun. 1973

R. L. Brooks and J. D. Pennewell 8 Jun. 1973 7 p

(Contract NAS9-13310)

(E73-10731; NASA-CR-133075; QPR-1) Avail: NTIS HC \$3.00 CSCL 08I

N73-26349*# Maine Dept. of Transportation, Augusta.

TO MAP THE DISTRIBUTION OF GLACIOFLUVIAL DEPOSITS AND ASSOCIATED GLACIAL LANDFORMS Progress Report, 1 May 1973

Raymond G. Woodman, Principal Investigator 1 May 1973 2 p ERTS

(Contract NAS5-21747)

(E73-10745; NASA-CR-133113; PR-6) Avail: NTIS HC \$3.00 CSCL 08L

N73-26362*# Kennecott Exploration, Inc., Salt Lake City, Utah. Exploration Services Dept.

RECOGNITION OF THE GEOLOGIC FRAMEWORK OF PORPHYRY DEPOSITS ON ERTS-1 IMAGERY Progress Report, Jan. - Jun. 1973

John C. Wilson, Principal Investigator 12 Jul. 1973 7 p ERTS

(Contract NAS5-21769)

(E73-10762; NASA-CR-132204) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. Photointerpretation methods have been most successfully applied in the less vegetated test sites where several previously unknown geologic features have been recognized and known ones extended. Northwest mid-Tertiary faults in the Ely, Nevada area are observed to offset north-trending ranges and abruptly terminate older Mesozoic structures. In the Ray, Arizona area the observed patterns of fault and fracture systems appear to be related to the locations of known porphyry copper deposits. In the Tanacross, Alaska area a number of regional circular features observed may represent near surface intrusions and, therefore, permissive environments for copper porphyries.

N73-27245*# Rockwell International Science Center, Thousand Oaks, Calif.

SEISMICITY AND RECENT FAULTING IN EASTERN CALIFORNIA AND WESTERN AND CENTRAL NEVADA: A PRELIMINARY REPORT Progress Report, Dec. 1972 - May 1973

Monem Abdel-Gawad, Principal Investigator, Joel Silverstein, and Linda Tubbesing Jun. 1973 48 p refs ERTS

(Contract NAS5-21767)

(E73-10769; NASA-CR-133136) Avail: NTIS HC \$4.50 CSCL 08K

The author has identified the following significant results. ERTS-1 imagery covering the eastern California-Nevada seismic belt were utilized to study the fault pattern in relation to the distribution of earthquake epicenters and Quaternary volcanic rocks. Many suspected faults not previously mapped were identified. These include several suspected shear zones in Nevada, faults showing evidence of recent breakage, and major lineaments. Highly seismic areas are generally characterized by Holocene faulting and Quaternary volcanic activity. However, several major

fault segments showing evidence of recent breakage are associated with little or no seismicity. The tectonic pattern strongly suggests that the eastern California-Nevada seismic belt coincides with a major crustal rift associated with zones of lateral shear. New data on potentially active fault zones have direct practical applications in national and local earthquake hazard reduction programs. Positive contacts have been made with Kern and Ventura Counties to make results of this investigation available for application to their earthquake hazards definition projects.

N73-27249*# Argus Exploration Co., Los Angeles, Calif.

EVIDENCE OF A MAJOR FAULT ZONE ALONG THE CALIFORNIA-NEVADA STATE LINE 35 DEG 30 MIN TO 36 DEG 30 MIN NORTH LATITUDE

Ira C. Bechtold, Principal Investigator, Mark A. Liggett, and John F. Childs Jul. 1973 13 p refs Original contains imagery.

Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21809)

(E73-10773; NASA-CR-133140) Avail: NTIS HC \$3.00 CSCL 08E

The author has identified the following significant results. Geologic reconnaissance guided by analysis of ERTS-1 and Apollo-9 satellite imagery and intermediate scale photography from X-15 and U-2 aircraft has confirmed the presence of a major fault zone along the California-Nevada state line, between 35 deg 30 min and 36 deg 30 min north latitude. The name Pahump Fault Zone has been suggested for this feature after the valley in which it is best exposed. Field reconnaissance has indicated the existence of previously unreported faults cutting bedrock along range fronts, and displacing Tertiary and Quaternary basin sediments. Gravity data support the interpretation of regional structural discontinuity along this zone. Individual fault traces within the Pahump Fault Zone form generally left-stepping en echelon patterns. These fault patterns, the apparent offset of a Laramide age thrust fault, and possible drag folding along a major fault break suggest a component of right lateral displacement. The trend and postulated movement of the Pahump Fault Zone are similar to the adjacent Las Vegas Shear Zone and Death Valley-Furnace Creek Faults, which are parts of a regional strike slip system in the southern Basin-Range Province.

N73-27250*# Argus Exploration Co., Los Angeles, Calif.

A RECONNAISSANCE SPACE SENSING INVESTIGATION OF CRUSTAL STRUCTURE FOR A STRIP FROM THE EASTERN SIERRA NEVADA TO THE COLORADO PLATEAU Progress Report, 1 Jan. - 30 Jun. 1973

Ira C. Bechtold, Principal Investigator, Mark A. Liggett, and John F. Childs Jul. 1973 45 p refs Original contains imagery.

Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21809)

(E73-10774; NASA-CR-133141) Avail: NTIS HC \$4.25 CSCL 08E

The author has identified the following significant results. Research progress in applications of ERTS-1 MSS imagery to study of Basin-Range tectonics is summarized. Field reconnaissance of ERTS-1 image anomalies has resulted in recognition of previously unreported fault zones and regional structural control of volcanic and plutonic activity. Nimbus, Apollo 9, X-15, U-2, and SIAR imagery are discussed with specific applications, and methods of image enhancement and analysis employed in the research are summarized. Field areas studied and methods employed in geologic field work are outlined.

N73-27252*# Indiana Geological Survey, Bloomington.

APPLICATION OF ERTS-A IMAGERY TO FRACTURE RELATED MINE SAFETY HAZARDS IN THE COAL MINING INDUSTRY Progress Report, Jan. - Jul. 1973

Charles E. Wier, Frank J. Wobber, Principal Investigators (Earth Satellite Corp., Washington, D. C.), R. V. Amato (Earth Satellite Corp., Washington, D. C.), and O. R. Russell Jul. 1973 79 p refs Original contains color imagery. Original photography may

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be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(Contract NAS5-21795)
(E73-10776; NASA-CR-133143) Avail: NTIS HC \$6.00 CSDL 081

The author has identified the following significant results. New fracture detail of Indiana has been observed and mapped from ERTS-1 imagery. Studies so far indicate a close relationship between the directions of fracture traces mapped from the imagery, fractures measured on bedrock outcrops, and fractures measured in the underground mines. A seasonal dependence of satellite fracture detection has been established based on vegetational tone differences and solar illumination angle. Numerous image enhancement techniques were tested for improved fracture detection and it was demonstrated that for glacial drift-covered areas of Indiana these techniques were of little value. Manual analysis procedures have, however, been successful. Previously unknown areas of mine subsidence have been observed and field checked. Subsidence-prone areas which are readily detectable on ERTS-1 imagery have been established. A prototype National Mined Lands inventory photomap was made to coincide with the Vincennes 1:250,000 map sheet and distributed to members of Congress and various governmental and mining industry officials. A fracture-lineament map and a mine hazards prediction map are being prepared to classify the test area by the relative potential of roof-fall hazards in future underground mining.

N73-27267* California Earth Science Corp., Santa Monica. **FAULT TECTONICS AND EARTHQUAKE HAZARDS IN THE PENINSULAR RANGES, SOUTHERN CALIFORNIA** Monthly Progress Report

Paul M. Merifield, Principal Investigator 5 Jul. 1973 3 p EREP

(Contract NAS9-13260)

(E73-10781; NASA-CR-133148; MPR-1) Avail: NTIS HC \$3.00 CSDL 08K

N73-27280* Iowa Univ., Iowa City. **EXPERIMENT TO EVALUATE FEASIBILITY OF UTILIZING SKYLAB-EREP REMOTE SENSING DATA FOR TECTONIC ANALYSIS OF THE BIGHORN MOUNTAINS REGION, WYOMING-MONTANA** Quarterly Report, 1 Mar. - 30 Jun. 1973

Richard A. Hoppin, Principal Investigator 30 Jun. 1973 1 p EREP

(Contract NAS9-13313)

(E73-10784; NASA-CR-133151) Avail: NTIS HC \$3.00 CSDL 08G

N73-27263* Geological Survey, Menlo Park, Calif. **IDENTIFICATION OF GEOSTRUCTURES OF CONTINENTAL CRUST, PARTICULARLY AS THEY RELATE TO MINERAL RESOURCE EVALUATION** Progress Report, 1 Mar. - 31 May 1973

George Gryc, Principal Investigator and Ernest H. Lathram 15 Jun. 1973 7 p refs ERTS

(NASA Order S-70243-AG-1)

(E73-10787; NASA-CR-133154) Avail: NTIS HC \$3.00 CSDL 08G

The author has identified the following significant results. The southeastward continuation of a fault that has been mapped in the vicinity of Den Creek, Alaska, shows up as a lineament on ERTS-1 image 1043-20163 that can be traced for more than 50 miles southeastward to beyond the Alaska-Canada boundary. The lineament probably reflects a major fault that is significant in understanding the complicated tectonics of the Wrangell Mountains-Saint Elias Mountains complex. From a study of the ERTS-1 image, low level vertical photography, and limited field work in the largely unmapped region, E.M. MacKevett, Jr., speculates that the eastern part of the fault may mark the southern boundary of a mild-Paleozoic metamorphic terrane that constitutes the westernmost known extent of the Alexander terrane of Berg, Jones, and Richter (1972) and correlates with the Kaskawulsh Group in Canada. This terrane, which consists dominantly of marble, was recognized during 1972 reconnaissance mapping in the east-central part of the McCarthy quadrangle by

MacKevett, D.L. Jones, and D.H. Richter and contrasts strongly with the dominantly volcanic and volcanoclastic terrane of Pennsylvanian and Permian age that forms the basement in most of the McCarthy quadrangle.

N73-27265* Geological Survey, Washington, D.C. **IRON-ABSORPTION BAND ANALYSIS FOR THE DISCRIMINATION OF IRON-RICH ZONES** Progress Report, 1 Mar. - 30 Apr. 1973

Lawrence C. Rowan, Principal Investigator 25 May 1973 4 p ERTS

(NASA Order S-70243-AG-4)

(E73-10789; NASA-CR-133156) Avail: NTIS HC \$3.00 CSDL 08G

N73-27275* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

APPLICATION OF ERTS AND EREP IMAGES TO GEOLOGIC INVESTIGATIONS OF THE BASIN AND RANGE: COLORADO PLATEAU BOUNDARY IN NORTHWESTERN AND NORTH CENTRAL ARIZONA Progress Report, 15 Apr. - 15 Jun. 1973

A. F. H. Goetz, F. C. Billingsley, D. P. Elston (Geol. Surv., Flagstaff, Ariz.), I. Lucchitta (Geol. Surv., Flagstaff, Ariz.), and E. M. Shoemaker (Calif. Inst. of Tech., Pasadena) 23 Jul. 1973 9 p refs Sponsored by NASA ERTS

(E73-10799; NASA-CR-133205) Avail: NTIS HC \$3.00 CSDL 08G

The author has identified the following significant results. Regional mapping using ERTS-1 images has led to the recognition of two parallel northeast-trending systems of normal faults, the Bright Angel and Mesa Butte fault systems, each of which can be traced at least 100 miles. Many eruptive centers appear to be localized along these fault systems or along their extensions. The faults are chiefly observed in Phanerozoic rocks and have minor displacement, but are interpreted to reflect fault zones of major displacement in the crystalline Precambrian basement. The location of epicenters of recent earthquakes and reports of earthquakes by residents in the region suggest that the Bright Angel and Mesa Butte fault systems are currently active.

N73-27277* Earth Satellite Corp., Washington, D.C. **APPLICATION OF EREP IMAGERY TO FRACTURE RELATED MINE SAFETY HAZARDS AND ENVIRONMENTAL PROBLEMS IN MINING** Quarterly Progress Report

Charles E. Wier, Frank J. Wobber, Principal Investigators, Roger V. Amato, and Orville R. Russell 17 Jul. 1973 3 p Prepared for Ind. Geol. Surv. EREP

(Contract NAS9-13358)

(E73-10802; NASA-CR-133209; QPR-1) Avail: NTIS HC \$3.00 CSDL 081

N73-27289* Colorado School of Mines, Golden, Dept. of Geology.

GEOLOGIC AND MINERAL AND WATER RESOURCES INVESTIGATIONS IN WESTERN COLORADO USING ERTS-1 DATA Progress Report, 31 Jun. - 11 Nov. 1972 Daniel H. Knepper, Principal Investigator Dec. 1972 49 p ERTS

(Contract NAS5-21778)

(E73-10814; NASA-CR-132754) Avail: NTIS HC \$4.50 CSDL 08G

The author has identified the following significant results. Preliminary geologic interpretations of selected ERTS-1 scenes in central and western Colorado indicate that lithologic discrimination and structural interpretation can be made on ERTS-1 images. Generally, lithologic units mapped on ERTS-1 images are composed of 2 or more recognized geologic formations and should more correctly be referred to as remote sensing units. Faults mapped on ERTS-1 images in western Colorado correspond well with faults mapped on the geologic map of Colorado (1:500,000). Stratigraphic offset was easily detected along faults as short as 3 km; it is anticipated that faults as short as 1/2-1 km should be identifiable. Several previously unmapped major linear features, possibly faults, were detected and mapped on ERTS-1

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imagery. Stereoscopic analysis of ERTS-1 imagery greatly enhances the capability of the interpreter. Structural features and lithologic contacts are more accurately traced and more remote sensing units (lithologic) can be defined. Ambiguous or questionable structural interpretations are commonly quickly resolved by stereoscopic analysis.

N73-27300*# New Mexico State Bureau of Mines and Mineral Resources, Socorro.

GEOLOGIC ANALYSIS AND EVALUATION OF ERTS-A IMAGERY FOR THE STATE OF NEW MEXICO Progress Report, 15 May - 14 Jul. 1973

Frank E. Kottowski, Principal Investigator and Karl VonderLinden
14 Jul. 1973 1 p ERTS
(Contract NAS5-21861)
(E73-10830; NASA-CR-133335) Avail: NTIS HC \$3.00 CSCL 08G

N73-27301*# South Carolina State Development Board, Columbia.

APPLICATION OF MULTISPECTRAL PHOTOGRAPHY TO MINERAL AND LAND RESOURCES OF SOUTH CAROLINA Quarterly Progress Report

Norman K. Olson, Principal Investigator 19 Jul. 1973 1 p EREP
(Contract NAS8-29617)
(E73-10831; NASA-CR-133336; QPR-1) Avail: NTIS HC \$3.00 CSCL 08G

N73-27332*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

NOTES FOR THE IMPROVEMENT OF A REMOTE SENSING MULTISPECTRAL DATA NON-SUPERVISED CLASSIFICATION AND MAPPING TECHNIQUE

Charles C. Dalton 27 Jul. 1973 33 p refs
(NASA-TM-X-64762) Avail: NTIS HC \$3.75 CSCL 08B

Examined are: (1) the sequential clustering technique for the unsupervised automatic classification and mapping of earth resources satellite data, (2) theoretical analysis of the tests which were used, and (3) derivation of an alternative set of tests and their necessary algorithm. Author

N73-27339*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

INVESTIGATIONS OF EARTH DYNAMICS FROM SATELLITE OBSERVATIONS

Edward M. Gaposchkin Mar. 1973 59 p refs
(Grant NGR-09-015-103)
(NASA-CR-133414) Avail: NTIS HC \$5.00 CSCL 08K

The consequences of the earth's elasticity are examined for close-earth satellites. The ideas of polar motion and earth tides are developed in a form applicable to satellite studies, since the polar motion, the body tide, and the ocean tide are all suitable for study by use of satellites. Analysis of available polar-motion data is performed. Author

N73-27356# Oklahoma State Univ., Stillwater.

REMOTE SENSING RESEARCH PROJECT: BIBLIOGRAPHY ON REMOTE SENSING APPLICATIONS IN GEOLOGY AND EARTH SCIENCES Interim Report No. 2

Mohamed Abdel-Hady, Mohamed El-Shazky, and Hassan Mostafa Nov. 1972 358 p refs Prepared in cooperation with Acad. of Sci. Res. and Technol., Cairo
(Grant NSF GF-31866)
(PB-219104/7; IR-2) Avail: NTIS CSCL 08G

Interim reports numbers 1, 2, and 3 together are a comprehensive bibliography of the remote sensing applications to agriculture, civil engineering, and geology. Each volume is divided into annotated and unannotated references. Volume 2, enclosed, is a bibliography on remote sensing applications in geology and earth sciences. Sensing methods are classified into aerial photography, infrared imagery, other remote sensors (radar,

ultraviolet, and multispectral), and processing techniques. The following areas are covered in this report in regard to the use of remote sensing techniques in their interpretation: drainage patterns, geomorphology, general geology, hydrogeology, mineral resources, and oceanography. Author (GRA)

N73-27359# Arizona Univ., Tucson. Office of Arid Lands Studies.

EXPLORATION AND EXPLOITATION OF GEOTHERMAL RESOURCES IN ARID AND SEMIARID LANDS: A LITERATURE REVIEW AND SELECTED BIBLIOGRAPHY Arid Lands Resource Information Paper No. 2

1973 125 p
(Contract DI-14-31-0001-3729)
(PB-218830/8; W73-07420; OWRR-W-144(2)) Avail: NTIS HC \$5.45 CSCL 08G

Contemporary techniques for exploration of geothermal resources are outlined, with particular emphasis on the western U.S. as typical of problems encountered in arid and semiarid lands. These include field reconnaissance, infrared aerial reconnaissance, photogeologic mapping, drilling, geochemical analysis of ground water, application of fluid dynamics to natural steam systems, electrical prospecting, seismic, gravity, and magnetic surveys. Environmental impacts, including noise, odors, subsidence, and legal problems involving developmental regulations, are reviewed. (Author Modified Abstract)

N73-28205*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Geological Sciences.

GEOLOGIC LANDFORM ANALYSIS IN THE CENTRAL PIEDMONT OF VIRGINIA AND NORTH CAROLINA, 1 Interim Report, Mar. - Aug. 1973

Lynn Glover, III, Principal Investigator 1 Aug. 1973 9 p ref ERTS
(Contract NAS5-21729)
(E73-10766; NASA-CR-133206) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. ERTS-1 imagery in the central Piedmont of Va. and N.C. reveals some geologic structures in the Precambrian and Paleozoic metamorphic terrain as well as structure in the younger Triassic deposits. A major synform five miles wide and more than 20 miles long has been identified in the metamorphic rocks north of Danville, Va. Structures in the metavolcanic Carolina slate belt are also identifiable near the confluence of the Dan and Staunton Rivers. Cleared land and other cultural features tend to coincide with topographic reflection of geologic units, thus enhancing the ERTS-1 resolution of some geologic structures. In other cases pseudostructures may be identified when regular geometric configurations of culture bear little or no relation to underlying geologic units. Interpreting geologic structure in the nearly flat and deeply weather Piedmont is a severe test of ERTS-1 imagery resolution. Doubling the resolution and providing stereoscopic overlap would increase the geologic usefulness of these photographs many fold.

N73-28233*# New York State Museum and Science Service, Albany.

EVALUATION OF ERTS-1 IMAGERY FOR GEOLOGICAL SENSING OVER THE DIVERSE GEOLOGICAL TERRAINS OF NEW YORK STATE

Yngvar W. Isachsen, Robert H. Fakundiny, and Stephen W. Forster In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 223-230 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21764)
(Paper-G1) CSCL 08G

Film positives of ERTS-1 imagery, both as received from NASA and photographically reprocessed, are analyzed by conventional and color additive viewing methods. The imagery reveals bedrock and surficial geological information at various scales. Features which can be identified to varying degrees include

boundaries between major tectonic provinces, lithological contacts, foliation trends within massive gneisses, faults, and topographic lineaments. In the present imagery the greatest amount of spectral geology is displayed in the Adirondack region where bedrock geology is strongly linked to topography. Within this basement complex, the most prominently displayed features are numerous north-northeast trending faults and topographic lineaments, and arcuate east-west valleys developed in some of the weaker metasedimentary rocks. The majority of the faults and lineaments shown on the geologic Map of New York at 1:250,000 appear in the ERTS imagery. Author

N73-28234* Pennsylvania State Univ., University Park. Dept. of Geosciences.

ANALYSIS AND APPLICATION OF ERTS-1 DATA FOR REGIONAL GEOLOGICAL MAPPING

D. P. Gold, R. R. Parizek, and S. A. Alexander /in NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 231-245 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-G2) CSCL 08G

Combined visual and digital techniques of analysing ERTS-1 data for geologic information have been tried on selected areas in Pennsylvania. The major physiographic and structural provinces show up well. Supervised mapping, following the imaged expression of known geologic features on ERTS band 5 enlargements (1:250,000) of parts of eastern Pennsylvania, delimited the Diabase Sills and the Precambrian rocks of the Reading Prong with remarkable accuracy. From unsupervised mapping, transgressive linear features are apparent in unexpected density, and exhibit strong control over river valley and stream channel directions. They are unaffected by bedrock type, age, or primary structural boundaries, which suggests they are either rejuvenated basement joint directions on different scales, or they are a recently impressed structure possibly associated with a drifting North American plate. With ground mapping and underflight data, 8 scales of linear features have been recognized. Author

N73-28235* Utah Univ., Salt Lake City. Dept. of Geological and Geophysical Sciences.

GEOLOGY OF UTAH AND NEVADA BY ERTS-1 IMAGERY

Mead LeRoy Jensen /in NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 247-255 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-G3) CSCL 08G

Repetitive ERTS-1 imagery covering Utah and Nevada is studied as an aid in structural geology, mineral exploration, and limnological and hydrological aspects. Limnological features of algal blooms and varying biological activities in Utah Lake and the Great Salt Lake are grossly evident on the imagery with more subtle details detected on the different bands. Major structural breaks, lineages, or trends are abundant throughout the area of study. The correlation of positive aeromagnetic anomalies with the trends suggests near surface intrusive bodies, not yet exposed at the surface, that can be tested for possible associated mineralization by collecting soil-gas at the surface which is analyzed for mercury that is (1) apparently associated with mineralization, (2) escapes as a vapor, and (3) can be readily measured in extremely low amounts of less than 1 ppb by absorption. Author

N73-28237* Bureau de Recherches Geologiques et Minieres, Orleans (France).

CAPABILITY OF ERTS-1 IMAGERY TO INVESTIGATE GEOLOGICAL AND STRUCTURAL FEATURES IN A SEDIMENTARY BASIN (BASSIN PARISIEN, FRANCE)

Claude Cavalier, Jean-Yves Scanvic, Guy Wecksteen, and Alain Ziserman /in NASA. Goddard Space Flight Center Symp. on

Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-G6) CSCL 08G

A preliminary study of the MSS imagery of a sedimentary basin whose structure is regular is reported. Crops and natural vegetation are distributed all over the site located under temperate climate. Ground data available concern plant species geology and tectonic and are correlated with results from ERTS 1 imagery. This comparison shows a good correlation. The main geological units are detected or enhanced by way of agricultural land use and/or natural vegetation. Alluvial deposits are outlined by vegetation grass land and poplar trees. Some spatial relationship of geostructures, suspected until now, are identified or extended in associating results from different spectral bands. Author

N73-28240* National Center for Earthquake Research, Menlo Park, Calif.

ESTABLISHMENT, TEST AND EVALUATION OF A PROTOTYPE VOLCANO SURVEILLANCE SYSTEM

Peter L. Ward, Jerry P. Eaton, Elliot Endo, David Harlow, Daniel Marquez, and Rex Allen /in NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 305-315 refs ERTS

(Paper-G9) CSCL 08E

A volcano-surveillance system utilizing 23 multilevel earthquake counters and 6 biaxial borehole tiltmeters is being installed and tested on 15 volcanoes in 4 States and 4 foreign countries. The purpose of this system is to give early warning when apparently dormant volcanoes are becoming active. The data are relayed through the ERTS-Data Collection System to Menlo Park for analysis. Installation was completed in 1972 on the volcanoes St. Augustine and Iliamna in Alaska, Kilauea in Hawaii, Baker, Rainier and St. Helens in Washington, Lassen in California, and at a site near Reykjavik, Iceland. Installation continues and should be completed in April 1973 on the volcanoes Santiaguito, Fuego, Agua and Pacaya in Guatemala, Izalco in El Salvador and San Cristobal, Telica and Cerro Negro in Nicaragua. Author

N73-28241* Geological Survey, Washington, D.C.

SATELLITE GEOLOGICAL AND GEOPHYSICAL REMOTE SENSING OF ICELAND: PRELIMINARY RESULTS FROM ANALYSIS OF MSS IMAGERY

Richard S. Williams, Agust Boedvarsson (Icelandic Surveying Dept., Reykjavik), Sturla Fridriksson (Agr. Inst., Reykjavik), Gudmundur Palmason (Natl. Energy Authority, Reykjavik), Sigurjon Rist (Natl. Energy Authority, Reykjavik), Hlynur Sigtryggsson (Icelandic Meteorol. Serv. Reykjavik), Sigurdur Thorarinnsson (Iceland Univ., Reykjavik), and Ingvi Thorsteinsson (Agr. Inst., Reykjavik) /in NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 317-327 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-G10) CSCL 08G

A binational, multidisciplinary research effort in Iceland is directed at an analysis of MSS imagery from ERTS-1 to study a variety of geologic, hydrologic, oceanographic, and agricultural phenomena. A preliminary evaluation of available MSS imagery of Iceland has yielded several significant results - some of which may have direct importance to the Icelandic economy. Initial findings can be summarized as follows: (1) recent lava flows can be delineated from older flows at Askja and Hekla; (2) MSS imagery from ERTS-1 and VHRR visible and infrared imagery from NOAA-2 recorded the volcanic eruption on Heimaey, Vestmann Islands; (3) coastline changes, particularly changes in the position of bars and beaches along the south coast are mappable; and (4) areas covered with new and residual snow can be mapped, and the appearance of newly fallen snow on ERTS-1, MSS band 7 appears dark where it is melting. ERTS-1

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imagery provides a means of updating various types of maps of Iceland and will permit the compilation of special maps specifically aimed at those dynamic environmental phenomena which impact on the Icelandic economy. Author

N73-28242* Gregory Geoscience Ltd., Ottawa (Ontario). **PRELIMINARY ASSESSMENT OF GEOLOGICAL APPLICATIONS OF ERTS-1 IMAGERY FROM SELECTED AREAS OF THE CANADIAN ARCTIC**

Alan F. Gregory *In* NASA. Goddard Space flight Center. Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 329-343 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota avenue, Sioux Falls, S. D. 57198 ERTS

(PAPER-G11) CSCL 08G

An assessment of geological applications of ERTS-1 imagery from selected areas of the Canadian Arctic is presented. The three levels of interpretation which may be recognized and employed to derive information from a single image or data format are outlined. It is stated that one immediate benefit from ERTS will be improved efficiency in planning for and operation of programs of regional geological mapping. Imagery of various areas of Canada are presented to show applications to regional mapping. Author

N73-28244* Geological Survey, Denver, Colo. **MAPPING QUATERNARY LANDFORMS AND DEPOSITS IN THE MIDWEST AND GREAT PLAINS BY MEANS OF ERTS-1 MULTISPECTRAL IMAGERY**

Roger B. Morrison *In* NASA. Goddard Space Flight Center. Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 353-361 ERTS (For availability see N73-28207 19-13)

(Paper-G13) CSCL 08B

ERTS-1 multispectral images are proving effective for differentiating many kinds of Quaternary surficial deposits and landforms units in Illinois, Iowa, Missouri, Kansas, Nebraska, and South Dakota. Examples of features that have been distinguished are: (1) the more prominent end moraines of the last glaciation; (2) certain possible palimpsests of older moraines mantled by younger deposits; (3) various abandoned river valleys, including suspected ones deeply filled by deposits; (4) river terraces; and (5) some known faults and a few previously unmapped lineaments that may be faults. The ERTS images are being used for systematic mapping of Quaternary landforms and deposits in about 20 potential study areas. Some study areas, already well mapped, provide checks on the reliability of mapping from the images. For other study areas, previously mapped only partly or not at all, our maps will be the first comprehensive, synoptic ones, and should be useful for regional land-use planning and ground-water, engineering-geology, and other environmental applications. Author

N73-28246* Missouri Geological Survey and Water Resources, Rolla.

FIRST LOOK ANALYSIS OF GEOLOGIC GROUND PATTERNS ON ERTS-1 IMAGERY OF MISSOURI

William H. Allen, James A. Martin, and David L. Rath *In* NASA. Goddard Space Flight Center. Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 371-378 refs ERTS

(Paper-G15) CSCL 08G

Examination of ERTS-1 data for selected areas of Missouri revealed not only many of the known geologic features but also a number of unknown linear, circular and arcuate ground patterns. The number of new geologic elements that have been brought to light as well as the sharp definition and probable extensions of several known geologic features point out the importance of multispectral imagery via satellite and the synoptic views which they provide. To date, analysis and interpretations have been a first-look visual examination of the unenhanced projected images. Author

N73-28247* Environmental Research Inst. of Michigan, Ann Arbor.

RATIO MAPS OF IRON ORE DEPOSITS ATLANTIC CITY DISTRICT, WYOMING

Robert K. Vincent *In* NASA. Goddard Space Flight Center. Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 379-386 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21783)

(Paper-G16) CSCL 08B

Preliminary results of a spectral rationing technique are shown for a region at the southern end of the Wind River Range, Wyoming. Digital ratio graymaps and analog ratio images have been produced for the test site, but ground truth is not yet available for thorough interpretation of these products. ERTS analog ratio images were found generally better than either ERTS single-channel images or high altitude aerial photos for the discrimination of vegetation from non-vegetation in the test site region. Some linear geological features smaller than the ERTS spatial resolution are seen as well in ERTS ratio and single-channel images as in high altitude aerial photography. Geochemical information appears to be extractable from ERTS data. Good preliminary quantitative agreement between ERTS-derived ratios and laboratory-derived reflectance ratios of rocks and minerals encourage plans to use lab data as training sets for a simple ratio gating logic approach to automatic recognition maps. Author

N73-28248* Geological Survey, Washington, D.C. **USE OF ERTS-1 IMAGES IN THE SEARCH FOR PORPHYRY COPPER DEPOSITS IN PAKISTANI BALUCHISTAN**

Robert G. Schmidt *In* NASA. Goddard Space Flight Center. Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 387-394 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-G17) CSCL 08I

Geomorphic features related to a known porphyry copper deposit at Saindak, western Chagai District, Pakistan, are easily distinguished on ERTS-1 images. New geologic information from the images was used in conjunction with known geology to evaluate one previously known prospect area and to suggest two additional ones, but no new prospects were recognized on the basis of the images alone. The study also showed that Saindak-type deposits are not likely to be present in some extensive areas of the Chagai District. The Saindak deposit is in an area of relatively easily eroded folded sedimentary and volcanic rocks. The deposit is characterized by an elongate zone of easily eroded sulfide-rich rock surrounded by this rim and the central sulfide-rich valley are conspicuous features on the images. Swarms of dikes are probably useful for distinguishing real rims from other resistant rock types, but there is no expression of them on the image, although they are easily seen on aerial photographs of the Saindak rim. Author

N73-28249* Stanford Univ., Calif. Dept. of Geology. **RELATION OF ERTS-1 DETECTED GEOLOGIC STRUCTURE TO KNOWN ECONOMIC ORE DEPOSITS**

Ernest I. Rich *In* NASA. Goddard Space Flight Center. Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 395-402 refs Original Contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-G18) CSCL 08G

A preliminary analysis of ERTS-1 imagery of the Northern Coast Ranges and Sacramento Valley, California, has disclosed a potentially important fracture system which may be one of the controlling factors in the location of known mercury deposits in the Coast Ranges and which appears to be associated with some of the oil and gas fields within the Sacramento Valley. Recognition of this fracture system may prove to be an extremely useful exploration tool, hence careful analysis of subsequent ERTS imagery might delineate areas for field evaluation. Author

N73-28250* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

PRELIMINARY GEOLOGIC INVESTIGATIONS IN THE COLORADO PLATEAU USING ENHANCED ERTS IMAGES
Alexander F. H. Goetz, Fred C. Billingsley, Donald Elston ((Geol. Surv., Flagstaff, Ariz.), Ivo Luccitta (Geol. Surv., Flagstaff, Ariz.), and Eugene M. Shoemaker (Calif. Inst. of Tech., Pasadena) *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 403-411 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-G19) CSCL 08G

Bulk and computer enhanced frames of the Verde Valley region of Central Arizona, have been analyzed for structural information and rock unit identification. Most major rock units in areas of sparse ground cover are identifiable on enhanced false-color composites. Regional structural patterns are strikingly visible on the ERTS images. New features have been identified which will aid in the search for ground water near Flagstaff, Sedona and Stewart Ranch. Author

N73-28251* Geological Survey, Washington, D.C.
STRUCTURAL GEOLOGIC ANALYSIS OF NEVADA USING ERTS-1 IMAGES: A PRELIMINARY REPORT

Lawrence C. Rowan and Pamela H. Wetlaufer *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 413-423 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-G20) CSCL 08G

Structural analysis of Nevada using ERTS-1 images shows several previously unrecognized lineaments which may be the surface manifestations of major fault or fracture zones. Principle trends are NE, NW, NNE-NNW, and ENE. Two lineament zones, the Walker Lane and Midas Trench lineament system, transect the predominantly NNE-NNW trending mountain ranges for more than 500 km. 50 circular features have been delineated. Comparison with known Tertiary volcanic centers and reference to geologic maps suggest 8 new centers. Preferred distribution of mines and Tertiary volcanic centers along some of the major lineament suggests a genetic relationship. The intersection of three previously unmapped lineaments in northwestern Nevada is the location of a highly productive metallogenic district. In the Walker Lane, ENE-trending lineament appear to be related to the occurrence of productive ore deposits. Author

N73-28252* Argus Exploration Co., Newport Beach, Calif.
REGIONAL TECTONIC CONTROL OF TERTIARY MINERALIZATION AND RECENT FAULTING IN THE SOUTHERN BASIN-RANGE PROVINCE, AN APPLICATION OF ERTS-1 DATA

I. C. Bechtold, M. A. Liggett, and J. F. Childs *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 425-432 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-G21) CSCL 08G

Research based on ERTS-1 MSS imagery and field work in the southern Basin-Range Province of California, Nevada and Arizona has shown regional tectonic control of volcanism, plutonism, mineralization and faulting. This paper covers an area centered on the Colorado River between 34 15' N and 36 45' N. During the mid-Tertiary, the area was the site of plutonism and genetically related volcanism fed by fissure systems now exposed as dike swarms. Dikes, elongate plutons, and coeval normal faults trend generally northward and are believed to have resulted from east-west crustal extension. In the extensional province, gold silver mineralization is closely related to Tertiary igneous activity. Similarities in ore, structural setting, and rock types define a metallogenic district of high potential for exploration. The ERTS

imagery also provides a basis for regional inventory of small faults which cut alluvium. This capability for efficient regional surveys of Recent faulting should be considered in land use planning, geologic hazards study, civil engineering and hydrology. Author

N73-28253* Rockwell International Science Center, Thousand Oaks, Calif.

ERTS APPLICATIONS IN EARTHQUAKE RESEARCH AND MINERAL EXPLORATION IN CALIFORNIA

Monem Abdel-Gawad and Joel Silverstein *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 433-450 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-G22) CSCL 08E

Examples that ERTS imagery can be effectively utilized to identify, locate, and map faults which show geomorphic evidence of geologically recent breakage are presented. Several important faults not previously known have been identified. By plotting epicenters of historic earthquakes in parts of California, Sonora, Mexico, Arizona, and Nevada, we found that areas known for historic seismicity are often characterized by abundant evidence of recent fault and crustal movements. There are many examples of seismically quiet areas where outstanding evidence of recent fault movements is observed. One application is clear: ERTS-1 imagery could be effectively utilized to delineate areas susceptible to earthquake recurrence which, on the basis of seismic data alone, may be misleadingly considered safe. ERTS data can also be utilized in planning new sites in the geophysical network of fault movement monitoring and strain and tilt measurements. Author

N73-28254* Alaska Univ., Fairbanks. Geophysical Inst.
SOME ASPECTS OF ACTIVE TECTONISM IN ALASKA AS SEEN ON ERTS-1

Larry D. Gedney and James D. VanWormer *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 451-457 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-G23)

ERTS-1 imagery is proving to be exceptionally useful in delineating structural features in Alaska which have never been recognized on the ground. Previously unmapped features such as seismically active faults and major structural lineaments are especially evident. Among the more significant results of this investigation is the discovery of an active strand of the Denali fault. The new fault has a history of scattered seismicity and was the scene of a magnitude 4.8 earthquake on October 1, 1972. Perhaps of greater significance is the disclosure of a large scale conjugate fracture system north of the Alaska Range. This fracture system appears to result from compressive stress radiating outward from around the outside of the great bend of the Alaska Range at Mt. McKinley. Author

N73-28255* Geological Survey, Washington, D.C.
ERTS-1 IMAGE CONTRIBUTES TO UNDERSTANDING OF GEOLOGIC STRUCTURES RELATED TO MANAGUA EARTHQUAKE, 1972

W. D. Carter and G. P. Eaton *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 459-471 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-G24) CSCL 08G

ERTS-1 imaged the western portion of Nicaragua on December 24, 1972, one day after the central part of the city of Managua was devastated by a major earthquake which measured 5.6 on the Richter scale. ERTS-1 images reveal sets of lineaments (which may reflect fault systems) along any one of which movement could have taken place. One set includes a line of active volcanoes that parallels the coast and constitutes

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the southwestern edge of the Nicaraguan Depression, a regional graben which cuts obliquely across the Central American isthmus. This trend is offset approximately 10km in a right lateral geometric sense just west of the city of Managua. A parallel lineament, north of Lake Managua, marks the northeast edge of the graben. A second set, extends northward to northwestward from the mouth of the Rio Grande (Viejo) north of Lake Managua and can be projected southward across the lake to Managua. It is this set along which geometric offset of the volcanic lineament appears to have taken place. Author

N73-28259° Purdue Univ., Lafayette, Ind.

RECOGNITION OF SURFACE LITHOLOGIC AND TOPOGRAPHIC PATTERNS IN SOUTHWEST COLORADO WITH ADP TECHNIQUES

Wilton N. Melhorn and Scott Sinnock *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 473-481 refs ERTS

(Paper-G25) CSCL 08M

Analysis of ERTS-1 multispectral data by automatic pattern recognition procedures is applicable toward grappling with current and future resource stresses by providing a means for refining existing geologic maps. The procedures used in the current analysis, already yield encouraging results toward the eventual machine recognition of extensive surface lithologic and topographic patterns. Automatic mapping of a series of hogbacks, strike valleys, and alluvial surfaces along the northwest flank of the San Juan Basin in Colorado can be obtained by minimal man-machine interaction. The determination of causes for separable spectral signatures is dependent upon extensive correlation of micro- and macro field based ground truth observations and aircraft underflight data with the satellite data. Author

N73-28267° Johannesburg Consolidated Investment Co. Ltd., Randfontein (Republic of South Africa). Geological Research Dept.

ERTS-1 IMAGERY AS AN AID TO THE DEFINITION OF THE GEOTECTONIC DOMAINS OF THE SOUTHERN AFRICAN CRYSTALLINE SHIELD

Morris J. Viljoen and Richard P. Viljoen *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 483-491 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-G28) CSCL 08G

Portions of two geotectonic environments in South Africa have been studied on ERTS-1 imagery. It was found that the broad synoptic view provided by this imagery is ideally suited to a study of the diagnostic macro-structures, and that the different geotectonic styles are clearly recorded. ERTS-1 imagery thus allows a more accurate definition than exists at present of the contact zones and internal structures of the two domains. The importance of this investigation as an aid to gaining an insight into the relevance of plate tectonics in Precambrian times is briefly discussed. Author

N73-28268° Ludwig-Maximilians-Universitat, Munich (West Germany). Zentralstelle fuer Geo-Photogrammetrie und Fernerkundung.

NEW ASPECTS ON THE TECTONIC OF THE ALPS AND THE APENNINES REVEALED BY ERTS-1 DATA

J. Bodochtel and B. Lammerer *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 493-499 refs ERTS

(Paper-G27) Avail: NTIS CSCL 08E

An analysis of the tectonic situation in the Alps and Apennine Mountains based on ERTS-1 imagery is presented. It is stated that the ERTS-1 imagery reveals connections between shearing systems of more than regional importance which could not be determined previously. The tracing of locally known fault distances by ERTS-1 imagery is discussed. Author

N73-28258° Steffensen (Roberto), Ottawa (Ontario).

STRUCTURAL LINEAMENTS OF GASPE FROM ERTS IMAGERY

Roberto Steffensen *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 501-515 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-G28) CSCL 08G

A test study was conducted to assess the value of ERTS images for mapping geologic features of the Gaspé Peninsula, Quebec. The specific objectives of the study were: 1) to ascertain the best procedure to follow in order to obtain valuable geologic data as a result of interpretation; and 2) to indicate in which way these data could relate to mineral exploration. Of the four spectral bands of the MultiSpectralScanner, the band from 700 to 800 nanometers, which seems to possess the best informational content for geologic study, was selected for analysis. The original ERTS image at a scale of 1:3,700,000 was enlarged about 15 times and reproduced on film. Geologically meaningful lines, called structural lineaments, were outlined and classified according to five categories: morpho-lithologic boundaries, morpho-lithologic lineaments, fault traces, fracture zones and undefined lineaments. Comparison with the geologic map of Gaspé shows that morpho-lithologic boundaries correspond to contacts between regional stratigraphic units. Morpho-lithologic lineaments follow bedding trends, whereas fracture traces appear as sets of parallel lineaments, intersecting at high angles the previous category of lineaments. Fault traces mark more precisely the location of faults already mapped and spot the presence of presumable faults, not indicated on the geologic map. Author

N73-28260° Geological Survey, Washington, D.C.

LINEAMENTS IN COASTAL PLAIN SEDIMENTS AS SEEN IN ERTS IMAGERY

Charles F. Withington *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 517-521 ref Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-G29) CSCL 08J

Examination of satellite imagery over the Atlantic Coastal Plain near Washington, D. C. shows numerous lineaments, which cannot be accounted for by any known cultural or natural features. At least some of these lineaments represent the surface expression of faults, for one of them has been correlated with the outcrop of a fault that had been traced for several miles in southern Prince Georges County, Maryland. If a substantial number of these lineaments do indeed represent fault traces, the fact that they show on the surface suggests that the geologic history of the Coastal Plain is much more complex than has previously been recognized, and that faulting may have occurred in the Holocene, much later than has generally been recognized. The importance that such recent movements could have on future development of the Coastal Plain should be emphasized. Author

N73-28261° Texas Instruments, Inc., Dallas.

EVALUATION OF COMMERCIAL UTILITY OF ERTS-A IMAGERY IN STRUCTURAL RECONNAISSANCE FOR MINERALS AND PETROLEUM

Donald F. Saunders and Gilbert E. Thomas *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 523-530 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-G30) CSCL 08G

Five areas in North America (North Slope-Alaska, Superior Province-Canada, Williston Basin-Montana, Colorado and New Mexico-West Texas) are being studied for discernibility of geological evidence on ERTS-1 imagery. Evidence mapped is compared with known mineral/hydrocarbon accumulations to determine the value of the imagery in commercial exploration programs. Evaluation has proceeded in the New Mexico-West

Texas area while awaiting imagery in the other areas. To date, results have been better than expected. Clearly discernible structural lineaments in New Mexico-West Texas are evident on the photographs. Comparison of this evidence with known major mining localities in New Mexico indicates a clear pattern of coincidence between the lineaments and mining localities. In West Texas, lineament and geomorphological evidence obtainable from the photographs define the petroleum-productive Central Basin Platform. Based on evaluation results in the New Mexico-West Texas area and on cursory results in the other four areas of North America, ERTS-1 imagery will be extremely valuable in defining the regional and local structure in any commercial exploration program. Author

N73-26202° Iowa Univ., Iowa City. Dept. of Geography. **STRUCTURAL INTERPRETATIONS BASED ON ERTS-1 IMAGERY, BIGHORN REGION, WYOMING-MONTANA** Richard A. Hoppin /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 531-538 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-G31) CSCL 08E

Structural analysis is being carried out on bands MSS 5 and 7 of scene 1085-17294. Geologic structure is primarily revealed in the topographic relief and drainage. Topographic linears are particularly well developed in the bighorn uplift. Many of these occur along known faults and shear zones in the Precambrian core; several have not been previously mapped. These linears, however, do not continue into the younger rocks of the flanks or do so in a much less marked manner than in the core. Linears are far less abundant in the basin or are manifested only in very subtle tonal contrasts and somewhat straight drainage segments. Some of the linears are aligned along trends previously postulated on the basis of surface mapping to be lineaments. The imagery reveals little or no evidence of strike-slip displacements along these lineaments. Author

N73-26203° Montana Univ., Missoula. **APPLICABILITY OF ERTS-1 TO LINEAMENT AND PHOTO-GEOLOGIC MAPPING IN MONTANA: PRELIMINARY REPORT**

Robert M. Weidman, David D. Alt, Raymond E. Flood, Katherine T. Hawley, Linda K. Wackwitz, Richard B. Berg (Mont. Bur. of Mines and Geol.), and Willis M. Johns (Mont. Bur. of Mines and Geol.) /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 539-546 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-G32) CSCL 08B

A lineament map prepared from a mosaic of western Montana shows about 85 lines not represented on the state geologic map, including elements of a northeast-trending set through central western Montana which merit ground truth checking and consideration in regional structural analysis. Experimental fold annotation resulted in a significant local correction to the state geologic map. Photogeologic mapping studies produced only limited success in identification of rock types, but they did result in the precise delineation of a late Cretaceous or early Tertiary volcanic field (Adel Mountain field) and the mapping of a connection between two granitic bodies shown on the state map. Imagery was used successfully to map clay pans associated with bentonite beds in gently dipping Bearpaw Shale. It is already apparent that ERTS imagery should be used to facilitate preparation of a much needed statewide tectonic map and that satellite imagery mapping, aided by ground calibration, provides and economical means to discover and correct errors in the state geologic map. Author

N73-26204° California Univ., Riverside. Dept. of Geography. **A NEW FAULT LINEAMENT IN SOUTHERN CALIFORNIA** Robert W. Pease and Claude W. Johnson /In NASA. Goddard

Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 547-552 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (Paper-G33) CSCL 08E

ERTS-1 imagery clearly shows a 50-mile wide tectonic zone across Southern California oriented about 15 deg to the structures of the Transverse Ranges or with an azimuth of 70 deg. The zone is delineated on the imagery by terrian alignments and vegetational differences. A previously undiscovered tectonic lineament extends across the Mojave Desert and appears as a line of crustal upwarping. Pressure which would have caused this plus the occurrence of many thrust faults with the 70 deg azimuth indicate this to be a zone of crustal compression. Recent earthquake epicenters appear to be related to this compression zone rather than the traditional fault network of Southern California. Author

N73-26205° Indiana Geological Survey, Bloomington. **FRACTURE MAPPING AND STRIP MINE INVENTORY IN THE MIDWEST BY USING ERTS-1 IMAGERY**

Charles W. Wier, Frank J. Wobber (Earth Satellite Corp., Washington), Orville R. Russell, and Roger V. Amato (Earth Satellite Corp., Washington) /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 553-560 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-E1)

Analysis of the ERTS-1 imagery and high-altitude infrared photography indicates that useful fracture data can be obtained in Indiana and Illinois despite a glacial till cover. ERTS MSS bands 5 and 7 have proven most useful for fracture mapping in coal-bearing rocks in this region. Preliminary results suggest a reasonable correlation between image-detected fractures and mine roof-fall accidents. Information related to surface mined land, such as disturbed area, water bodies, and kind of reclamation, has been derived from the analysis of ERTS imagery. Author

N73-26310° Pennsylvania State Univ., University Park. Office for Remote Sensing of Earth Resources.

IDENTIFICATION AND MAPPING OF COAL REFUSE BANKS AND OTHER TARGETS IN THE ANTHRACITE REGION

F. Y. Borden, D. N. Thompson, and H. M. Lachowski /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1067-1074 refs ERTS (Paper-L24) CSCL 08G

ERTS-1 MSS data covering parts of Pennsylvania's southern and eastern middle anthracite coal fields were studied to determine how well accumulations of coal refuse could be identified and mapped by computer analysis and processing. Spectral signatures of coal refuse targets were similar to water, but had higher reflectances in all channels. Relative reflectances were in the order $4 > 5 > 6 > 7$. Although no underflight photography was at hand to judge mapping success, correlation was made, with 1:24,000 scale U.S.G.S. maps dated 1947 and 1948. Coal refuse targets correlated well with existing maps. Author

N73-26307° Paterson State Coll., N.J. Dept. of Geography. **ERTS-1 APPLIED FOR STRUCTURAL AND MORPHOLOGICAL INVESTIGATIONS CASE STUDIES. 1: LOS ANGELES, CALIFORNIA. 2: COASTAL PLAIN, NEW JERSEY**

Ervin Y. Kedar /In NASA. Goddard Space Flight Center Symp. on Significant Results Obtained from the ERTS-1, Vol. 1, Sect. A and B. 1973 p 1527-1538 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

CSCL 08E

Two major earth's resources management problems, the application of ERTS-1 imagery for geomorphotectonics, and

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subsequently seismic-risk, earthquake, and mineral exploration applications are discussed. Case studies are presented for Los Angeles, California, and New Jersey coastal plain. Author

N73-28368* Consiglio Nazionale delle Ricerche, Milan (Italy). Lab. per la Geofisica della Litosfera.

A PRELIMINARY EVALUATION OF ERTS-1 IMAGES ON THE VOLCANIC AREAS OF SOUTHERN ITALY

R. Cassinis and G. M. Lechi / In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1539-1548 Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

CSSL 08E

The test site selected for the investigation covers nearly all the regions of active and quiescent volcanism in southern Italy, i.e. the eastern part of the island of Sicily, the Aeolian Islands and the area of Naples. The three active European volcanoes (Etna, Stromboli and Vesuvius) are included. The investigation is in the frame of a program for the surveillance of active volcanoes by geophysical (including remote sensing thermal methods) and geochemical methods. By the multispectral analysis of ERTS-1 data it is intended to study the spectral behavior of the volcanic materials as well as the major geological lineaments with special reference to those associated with the volcanic region. Secondary objectives are also the determination of the hydrographic network seasonal behavior and the relationship between the vegetation cover and the different type of soils and rocks. Author

N73-28369* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THERMAL SURVEILLANCE OF CASCADE RANGE VOLCANOES USING ERTS-1 MULTISPECTRAL SCANNER, AIRCRAFT IMAGING SYSTEMS, AND GROUND-BASED DATA COMMUNICATION PLATFORMS

Jules D. Friedman (Geol. Survey, Washington D. C.), David G. Frank (Geol. Survey, Tacoma, Wash.), Duane Preble (Geol. Survey, Bay St. Louis, Mo.), and J. Earle Painter / In its Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1549-1560 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

CSSL 08E

A combination of infrared images depicting areas of thermal emission and ground calibration points have proved to be particularly useful in plotting time-dependent changes in surface temperatures and radiance and in delimiting areas of predominantly convective heat flow to the earth's surface in the Cascade Range and on Surtsey Volcano, Iceland. In an integrated experiment group using ERTS-1 multispectral scanner (MSS) and aircraft infrared imaging systems in conjunction with multiple thermistor arrays, volcano surface temperatures are relayed daily to Washington via data communication platform (DCP) transmitters and ERTS-1. ERTS-1 MSS imagery has revealed curvilinear structures at Lassen, the full extent of which have not been previously mapped. Interestingly, the major surface thermal manifestations at Lassen are aligned along these structures, particularly in the Warner Valley. Author

N73-28370* New Mexico State Bureau of Mines and Mineral Resources, Socorro.

INITIAL EVALUATION OF THE GEOLOGIC APPLICATIONS OF ERTS-1 IMAGERY FOR NEW MEXICO

Karl VonderLinden and Frank E. Kottowski / In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1561-1566 ERTS

CSSL 08G

Coverage of approximately one-third of the test site, the state of New Mexico, had been received by January 31, 1973 and all of the images received were MSS products. Features noted during visual inspection of 91/2 x 91/2 prints include major structural forms, vegetation patterns, drainage patterns and

outcrops of geologic formations having marked color contrasts. The Border Hills Structural Zone and the Y-O Structural Zone are prominently reflected in coverage of the Pecos Valley. A study of available maps and remote sensing material covering the Deming-Columbus area indicated that the limit of detection and the resolution of MSS products are not as good as those of aerial photographs, geologic maps, and manned-satellite photographs. The limit of detection of high contrast features on MSS prints in approximately 1000 feet or 300 meters for linear features and about 18 acres for roughly circular areas. Author

N73-28393* Geological Survey, Washington, D.C.

PRELIMINARY GEOLOGIC APPLICATION OF ERTS-1 IMAGERY IN ALASKA

Ernest H. Lathram, Irvin L. Tailleir, William W. Patton, Jr., and William A. Fischer / In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 2 May 1973 p 31-38 An earlier version of this paper was published in Volume 1, pages 257-264 Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

CSSL 08G

The geologic application of ERTS-1 imagery in Alaska is discussed. The results of the investigation are relevant to the three national problems of: (1) identifying minable minerals, (2) accelerating the finding and development of sources of petroleum and gas, and (3) the need to preserve the environment. The use of ERTS-1 imagery in developing a metallogenetic map of Alaska is described. Illustrations of the accomplishments produced by ERTS-1 data are provided. Author

N73-28398* Cincinnati Univ., Ohio.

MINERAL RESOURCES, GEOLOGIC STRUCTURE, AND LANDFORM SURVEYS

Laurence H. Lattman / In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 2 May 1973 p 107-114 Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

CSSL 08B

The use of ERTS-1 imagery for mineral resources, geologic structure, and landform surveys is discussed. Four categories of ERTS imagery application are defined and explained. The types of information obtained by the various multispectral band scanners are analyzed. Samples of land use maps and tectoning and metallogenetic models are developed. It is stated that the most striking features visible on ERTS imagery are regional lineaments, or linear patterns in the topography, which reflect major fracture zones extending upward from the basement of the earth. Author

N73-28408* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

MINERAL RESOURCES, GEOLOGICAL STRUCTURE AND LANDFORM SURVEYS

Nicholas M. Short / In its Symp. on Significant Results obtained from the ERTS-1, Vol. 3 May 1973 p 30-46 refs ERTS

CSSL 08G

Significant results are presented of ERTS-1 investigations of landform surveys, mineral resources, and geological structures. The report covers four areas: (1) mapping investigations; (2) dynamic surface processes and landforms; (3) structural elements; and (4) mineral deposits. A.L.

N73-28415* Colorado School of Mines, Golden. Dept. of Geology.

GEOLOGIC AND MINERAL AND WATER RESOURCES INVESTIGATIONS IN WESTERN COLORADO Progress Report, 1 Jun. - 31 Jul. 1973

Daniel H. Knepper, Jr., Principal Investigator 30 Jul. 1973 3 p ERTS

(Contract NAS5-21778)
(E73-10837; NASA-CR-133397) Avail: NTIS HC \$3.00 CSCL
08G

N73-28420* Alaska Univ., Fairbanks. Geophysical Inst.
**EVALUATION OF FEASIBILITY OF MAPPING SEISMICALLY
ACTIVE FAULTS IN ALASKA** Progress Report, Feb. - Jul.
1973

Larry Gedney and James D. VanWormer, Principal Investigators
31 Jul. 1973 13 p refs ERTS
(Contract NAS5-21833)
(E73-10842; NASA-CR-133404) Avail: NTIS HC \$3.00 CSCL
08G

The author has identified the following significant results. The sharp bend in the Alaska Range near 65 deg N, 150 deg W is now thought to enclose a corner of the northwesterly migrating north Pacific lithospheric plate. Subduction of the plate beneath the continent is believed, on the basis of hypocentral distribution, to occur along Cook Inlet and the eastern flanks of the Aleutian and Alaska Ranges as far northward as Mt. McKinley. The nature of tectonic deformation here, particularly in the area of the bend in the Alaska Range, is understandably complex. The Denali fault is thought to be a transform character in the vicinity of Mt. McKinley (i.e., it is thought to be the surface along which the oceanic plate separates from the continental plate). On the ERTS-1 imagery, however, it appears that there are a number of sub-parallel faults which branch off of the Denali fault in a southwesterly direction. Slippage along these would tend to squeeze material around the inside of the bend rather than the plate being directly underthrust. All of these sub-parallel faults are seismically active. The right-lateral fault-plane solution obtained for this event is consistent with the concept of slippage around the bend on a set of sub-parallel faults in the manner postulated. The best images to show these features are 1086-20444 and 1266-20572.

N73-28424* New York State Museum and Science Service,
Albany.

**TO EVALUATE ERTS-1 DATA FOR USEFULNESS AS A
GEOLOGICAL SENSOR IN THE DIVERSE GEOLOGICAL
TERRAINES OF NEW YORK STATE** Progress Report, period
ending 15 Aug. 1973

Yngvar W. Isachsen, Principal Investigator 16 Aug. 1973 8 p
ERTS
(Contract NAS5-21764)
(E73-10846; NASA-CR-133425) Avail: NTIS HC \$3.00 CSCL
08G

The author has identified the following significant results. Linear anomalies dominate the new geological information derived from ERTS-1 imagery, total lengths now exceeding 8000 kms. Experimentation with a variety of viewing techniques suggests that conventional photogeologic analyses of band 7 results in the location of more than 97 percent of all linears found. Bedrock lithologic types are distinguishable only where they are topographically expressed or govern land use signatures. The maxima on rose diagrams for ERTS-1 anomalies correspond well with those for mapped faults and topographic lineaments, despite a difference in relative magnitudes of maxima thought due to solar illumination direction. A multiscale analysis of linears showed that single topographic linears at 1:2,500,000 became dashed jugate linears at 1:500,000, and shorter linears lacking any conspicuous zonal alignment at 1:250,000. Most circular features found were explained away by U-2 airphoto analysis but several remain as anomalies. Visible glacial features include individual drumlins, best seen in winter imagery, drumlinoids, eskers, ice-marginal drainage channels, glacial lake shorelines and sand plains, and end moraines.

N73-28448* Colorado School of Mines, Golden. Dept. of
Geology.

**APPLICATION OF REMOTE SENSING TECHNIQUES TO THE
GEOLOGY OF THE BONANZA VOLCANIC CENTER**

Ronald W. Marris Mar. 1973 297 p refs
(Grant NGL-08-001-015)
(NASA-CR-133499; Rept-73-1) Avail: NTIS HC \$17.00 CSCL
08G

A program is reported for evaluating remote sensing as an aid to geologic mapping for the past four years. Data tested in this evaluation include color and color infrared photography, multiband photography, low sun-angle photography, thermal infrared scanner imagery, and side-looking airborne radar. The relative utility of color and color infrared photography was tested as it was used to refine geologic maps in previously mapped areas, as field photos while mapping in the field, and in making photogeologic maps prior to field mapping. The latter technique served as a test of the maximum utility of the photography. In this application the photography was used successfully to locate 75% of all faults in a portion of the geologically complex Bonanza volcanic center and to map and correctly identify 93% of all Quaternary deposits and 62% of all areas of Tertiary volcanic outcrop in the area. Author

N73-28453 Imperial Coll. of Science and Technology, London
(England).

**THE APPLICATION OF MULTISPECTRAL SCANNING
SYSTEMS TO GEOLOGY**

J. W. Norman /In Plessey Radar Res. Centre Multispectral
Scanning Systems and their Potential Appl. to Earth Resources
Surveys Apr. 1973 p 85-126 refs

The physical characteristics of soils and rocks are briefly reviewed and the discipline requirements considered. The application of multispectral scanning (MSS) to various areas of geology, e.g. hydro-petroleum, engineering, geology, volcanology, and mineral exploration is discussed. The interpretation problems are broached and various methods described. Finally recommendations for instrument development and testing, interpreter training, and automatic data processing are made.

ESRO

N73-29214* California Earth Science Corp., Santa Monica.
**FAULT TECTONICS AND EARTHQUAKE HAZARDS IN THE
PENINSULAR RANGES, SOUTHERN CALIFORNIA** Monthly
Progress Report, Jul. 1973

Paul M. Merifield, Principal Investigator 5 Aug. 1973 3 p
EREPR

(Contract NAS2-7698)
(E73-10863; NASA-CR-133452; MPR-2) Avail: NTIS HC
\$3.00 CSCL 08G

N73-29225* Geological Survey, Washington, D.C. EROS
Program Office.

**SATELLITE GEOLOGICAL AND GEOPHYSICAL REMOTE
SENSING OF ICELAND** Special Report No. 1

Richard S. Williams, Jr. and Guomundur Palmason (Natl. Energy
Authority, Reykjavik) 1 Aug. 1973 5 p refs Sponsored by
NASA ERTS

(E73-10874; NASA-CR-133491) Avail: NTIS HC \$3.00 CSCL
08L

N73-29226* Rockwell International Science Center, Thousand
Oaks, Calif.

**IDENTIFICATION AND INTERPRETATION OF TECTONIC
FEATURES FROM ERTS-1 IMAGERY** Progress Report,
1 Jun. - 31 Jul. 1973

Moham Abdel-Gawad, Principal Investigator 14 Aug. 1973
2 p ERTS

(Contract NAS5-21767)
(E73-10875; NASA-CR-133492) Avail: NTIS HC \$3.00 CSCL
08B

The author has identified the following significant results. Significant results from ERTS-1 imagery are: (1) Several new lineaments or faults have been identified. (2) Study of navigational maps and the ERTS-1 imagery suggests significant mapping errors in the geodetic position of Baja California.

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N73-29228# Environmental Research Inst. of Michigan, Ann Arbor.

MAPPING EXPOSED SILICATE ROCK TYPES AND EXPOSED FERRIC AND FERROUS COMPOUNDS FROM A SPACE PLATFORM Quarterly Report, 8 Mar. - 8 Jun. 1973

Robert K. Vincent, Principal Investigator 8 Jun. 1973 2 p EREP

(Contract NAS9-13317)

(E73-10877; NASA-CR-133494; QR-1) Avail: NTIS HC \$3.00 CSCL 08M

N73-29240# Montana Univ., Missoula. Dept. of Geology. **APPLICABILITY OF ERTS-1 TO MONTANA GEOLOGY** Interim Report, 1 Feb. - 31 Jul. 1973

Robert M. Woldman, Principal Investigator, D. Alt, R. Berg, W. Johns, R. Flood, K. Hawley, and L. Weckwitz 16 Aug. 1973 30 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21826)

(E73-10900; NASA-CR-133567) Avail: NTIS HC \$3.50 CSCL 08G

The author has identified the following significant results. A detailed band 7 ERTS-1 lineament map covering western Montana and northern Idaho has been prepared and is being evaluated by direct comparison with geologic maps, by statistical plots of lineaments and known faults, and by field checking. Lineament patterns apparent in the Idaho and Boulder batholiths do not correspond to any known geologic structures. A band 6 mosaic of Montana and adjacent areas has been laid and a lineament annotation prepared for comparison with the band 7 map. All work to date indicates that ERTS-1 imagery is very useful for revealing patterns of high-angle faults, though much less useful for mapping rock units and patterns of low-angle faults. Large-scale mosaics of U-2 photographs of three test sites have been prepared for annotation and comparison with ERTS-1 maps. Mapping of Quaternary deposits in the Glacier Lake Missoula basin using U-2 color infrared transparencies has been successful resulting in the discovery of some deposits not previously mapped. Detailed work has been done for Test Site 384 D using ERTS-1 imagery; criteria for recognition of several rock types have been found. Photogeologic mapping for southeastern Montana suggests Wasatch deposits where none are shown on the geologic map.

N73-29207# Colorado School of Mines, Golden. Dept. of Geology.

GEOLOGIC AND MINERAL AND WATER RESOURCES INVESTIGATIONS IN WESTERN COLORADO, USING SKYLAB EREP DATA Progress Letter Report, 1-31 Jul. 1973

Kennan Loo, Principal Investigator and Daniel H. Knoppor, Jr. 11 Aug. 1973 3 p EREP

(Contract NAS9-13394)

(E73-10918; NASA-CR-133575) Avail: NTIS HC \$3.00 CSCL 08G

N73-29200# Colorado School of Mines, Golden. Dept. of Geology.

GEOLOGIC AND MINERAL AND WATER RESOURCES INVESTIGATIONS IN WESTERN COLORADO, USING SKYLAB EREP DATA Progress Letter Report, 29 May - 30 Jun. 1973

Keenan Loo, Principal Investigator and Daniel H. Knoppor, Jr. 11 Aug. 1973 3 p EREP

(Contract NAS9-13394)

(E73-10919; NASA-CR-133576) Avail: NTIS HC \$3.00 CSCL 08G

N73-29272# Stanford Univ., Calif. School of Earth Sciences. **FEASIBILITY OF USING S-191 INFRARED SPECTRA FOR GEOLOGICAL STUDIES FROM SPACE** Monthly Report, Aug. 1973

R. J. P. Lyon and A. A. Green, Principal Investigators 27 Aug.

1973 4 p EREP

(Contract NAS9-13357)

(E73-10923; NASA-CR-133580; MR-1) Avail: NTIS HC \$3.00 CSCL 08G

N73-30278# Dartmouth Coll., Hanover, N.H. Dept. of Earth Sciences.

JULY 1973 GROUND SURVEY OF ACTIVE CENTRAL AMERICAN VOLCANOES Progress Report, May - Jul. 1973

Richard E. Stoiber, Principal Investigator and William I. Rose, Jr. (Michigan Technol. Univ., Houghton) Aug. 1973 33 p refs EREP

(Contract NAS9-13311)

(E73-10937; NASA-CR-133608) Avail: NTIS HC \$3.75 CSCL 08G

The author has identified the following significant results. Ground survey has shown that thermal anomalies of various sizes associated with volcanic activity at several Central American volcanoes should be detectable from Skylab. Anomalously hot areas of especially large size (greater than 500 m in diameter) are now found at Santiaguito and Pacaya volcanoes in Guatemala and San Cristobal in Nicaragua. Smaller anomalous areas are to be found at least seven other volcanoes. This report is completed after ground survey of eleven volcanoes and ground-based radiation thermometry mapping at these same points.

N73-30202# Alaska Univ., Fairbanks. Geophysical Inst. **GLACIOLOGICAL AND VOLCANOLOGICAL STUDIES IN THE WRANGELL MOUNTAINS, ALASKA** Biennial Technical Report, Feb. - Jul. 1973

Carl S. Bonson, Principal Investigator and Louis H. Shapiro 31 Jul. 1973 10 p ref ERTS

(Contract NAS5-21833)

(E73-10940; NASA-CR-133611; SATR-2) Avail: NTIS HC \$3.00 CSCL 08G

N73-29203# Stanford Univ., Calif. School of Earth Sciences. **STRUCTURAL AND LITHOLOGIC STUDY OF NORTHERN COAST RANGES AND SACRAMENTO VALLEY, CALIFORNIA** Progress Report, 1 Jul. - 1 Sep. 1973

Ernest I. Rich, Principal Investigator 1 Sep. 1973 3 p ERTS (Contract NAS9-21779)

(E73-10942; NASA-CR-133613) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. The pattern of linear oroclinal within the project area has been extended into the western foothill belt of the Sierra Nevada. The chief pattern of linear features in the western Sierran foothill belt trends about N. 10 - 15 deg W., but in the vicinity of the Feather River the trend of the features abruptly changes to about N. 60-60 deg W and appears to be contiguous across the Sacramento Valley with a similar system of linear features in the Coast Ranges. The linear features in the Modoc Plateau and Klamath Mt. areas appear unrelated to the system detected in the Coast Ranges of Sierran foothill belt. Although the change in trend of the Sierran structural features has been previously suggested and the interrelationship of the Klamath Mt. region with the northern Sierra Nevada has been postulated, the data obtained from the ERTS-1 imagery strengthens these notions and provides for the first time evidence of a direct connection of the structural trends within the alluviated part of the Sacramento Valley. In addition rocks of Pleistocene and Holocene age are offset by some of the linear features seen on ERTS-1 imagery and hence may record the latest episode of geologic deformation in north-central California.

N73-30201# Geological Survey, Denver, Colo. **EVALUATION OF ERTS-1 IMAGERY FOR MAPPING QUATERNARY DEPOSITS AND LANDFORMS IN THE GREAT PLAINS AND MIDWEST** Progress Report, 1 Jan. - 20 Feb. 1973

Regor B. Morrison, Principal Investigator and George R. Hallberg (Iowa Geological Survey, Iowa City) 1 Mar. 1973 14 p ERTS

(NASA Order S-70243-AG-1)

(E73-10949; NASA-CR-133625) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. The main landform associations and larger landforms are readily identifiable on the better images and commonly the gross associations of surficial Quaternary deposits also can be determined primarily by information on landforms and soils (obtained by analysis of stream dissection and drainage and stream-divide patterns, land use patterns, etc.). Maps showing the Quaternary geologic-terrain units that can be distinguished on the ERTS-1 images are being prepared for study areas in Illinois, Iowa, Missouri, Kansas, Nebraska, and South Dakota. Preliminary maps of 1:1,000,000 scale are included for three of the study areas: the Grand Island and Fremont, Nebraska, and the Davenport, Iowa-Illinois, 1 deg x 2 deg quadrangles. These maps exemplify the first phase of investigations, which consists of identifying and mapping landform and land use characteristics and geologic-surficial materials directly from the ERTS-1 images alone, with no additional information. These maps show that commonly the boundaries of geologic-terrain units can be delineated more accurately on ERTS-1 images than on topographic maps at 1:250,000 scale.

N73-30293* Geological Survey, Denver, Colo.
EVALUATION OF ERTS-1 IMAGERY FOR MAPPING QUATERNARY DEPOSITS AND LANDFORMS IN THE GREAT PLAINS AND MIDWEST Progress Report, 1 Mar. - 30 Apr. 1973

Roger B. Morrison, Principal Investigator and George R. Haliberg (Iowa Geological Survey, Iowa, City) 1 May 1973 10 p refs ERTS

(NASA Order S-70243-AG-1)

(E73-10951; NASA-CR-133627) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. The main landform associations and larger landforms are readily identifiable on the better images and commonly the gross associations of surficial Quaternary deposits also can be differentiated, primarily by information on landforms and soils. Maps showing the Quaternary geologic-terrain units that can be differentiated from the ERTS-1 images are being prepared for study areas in Illinois, Iowa, Missouri, Kansas, Nebraska, and South Dakota. Preliminary maps at 1:1 million scale are given of two of the study areas, the Peoria and Decatur, Illinois, 1 deg x 2 quadrangles. These maps exemplify the first phase of investigations, which consists of identifying and mapping landform and land use characteristics and geologic-surficial materials directly from ERTS-1 images alone, without input of additional data. These maps show that commonly the boundaries of geologic-terrain units can be identified more accurately on ERTS-1 images than on topographic maps of 1:250,000 scale. From analysis of drainage patterns, stream-divide relations, and tone and textural variations on the ERTS-1 images, the trends of numerous moraines of Wisconsinan and possibly some of Illinoian age were mapped. In the Peoria study area the trend of a buried valley of the Mississippi River is revealed.

N73-30300* Wyoming Univ., Laramie. Dept. of Geology.
GEOLOGY OF PHOTO LINEAR ELEMENTS, GREAT DIVIDE BASIN, WYOMING Special Report

D. L. Blackstone, Jr. 1 Jun. 1973 14 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21799)

(E73-10958; NASA-CR-133634) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. Ground examination of photo linear elements in the Great Divide Basin, Wyoming indicates little if any tectonic control. Aeolian aspects are more widespread and pervasive than previously considered.

N73-30302* Kennecott Exploration, Inc., Salt Lake City, Utah. Exploration Service Dept.

RECOGNITION OF THE GEOLOGIC FRAMEWORK OF PORPHYRY COPPER DEPOSITS ON ERTS-1 IMAGERY Progress Report

John C. Wilson, Principal Investigator 6 Sep. 1973 4 p ERTS

(Contract NAS5-21769)

(E73-10960; NASA-CR-133636) Avail: NTIS HC \$3.00 CSCL 08G

N73-30311* Earth Satellite Corp., Washington, D.C. Geosciences and Environmental Applications Div.

STUDY OF APPLICATION OF ERTS-A IMAGERY TO FRACTURE-RELATED MINE SAFETY HAZARDS IN THE COAL MINING INDUSTRY Progress Report, 1 Jul. - 1 Sep. 1973

Charles E. Wier (Indiana Geological Survey), Frank J. Wobber, Principal Investigators, Orville R. Russell, Roger V. Amato, and Thomas Leshendok 10 Sep. 1973 4 p ERTS

(Contract NAS5-21795)

(E73-10970; NASA-CR-133749) Avail: NTIS HC \$3.00 CSCL 08I

The author has identified the following significant results. The Kings Station Mine in Gibson County, Indiana has experienced considerable roof fall problems. Detailed fracture mapping of the mine area was done with ERTS-1 and aircraft imagery, and a prediction map of roof problem areas was produced in advance of a visit. The visit to the mine and discussions with the operator indicated that of four zones mapped as potential problem areas, three coincided with areas of excessive roof fall. This positive correlation of 75% lends confidence to the validity of the technique being applied in the investigation. The mine officials expressed an interest in the project and are anxious to see the final product maps which are forthcoming.

N73-30316 Joint Publications Research Service, Arlington, Va.
GENERAL PRINCIPLES OF GEOLOGICAL INTERPRETATION OF REMOTE IMAGES OF THE EARTH'S SURFACE In its Meeting of the Sov.-Am. Working Group on Remote Sensing of the Nat. Environment from Space (JPRS-59739) 8 Aug. 1973 p 16-19 refs Transl. into ENGLISH from the publ. "Vstrecha Sovetskoye-Amerikanskoye Rabochey Gruppy po Issledovaniyu Okruzhayushchey Sredy iz Kosmosa" Moscow, Acad. of Sci. USSR, 1973

The basic principles of geological interpretation of aerial photographs are reviewed and their application to the interpretation of images from space is discussed. The methodology of interpreting both space and aerial photographs is proposed as being based on the single primary principle of studying the interrelations between the different geological phenomena and processes and the peculiarities of the exhibition of such interrelations in the landscaped mantle. The interpretive attributes, both direct and indirect, of geological formations are defined and their significance is discussed. D.L.G.

N73-30320 Joint Publications Research Service, Arlington, Va.
EXAMPLES OF SOLVING CERTAIN REGIONAL GEOLOGICAL PROBLEMS USING PHOTOGRAPHS FROM SPACE In its Meeting of the Sov.-Am. Working Group on Remote Sensing of the Nat. Environment from Space (JPRS-59739) 8 Aug. 1973 p 20-30 refs Transl. into ENGLISH from the publ. "Vstrecha Sovetskoye-Amerikanskoye Rabochey Gruppy po Issledovaniyu Okruzhayushchey Sredy iz Kosmosa" Moscow, Acad. of Sci. USSR, 1973

A literature review is presented of geological interpretations of space photographs obtained by Soviet and US satellites. Two principle areas are discussed in which these photographs are of extreme importance. These prime areas of application include: (1) use of the space photographs for defining the geological and tectonic maps more precisely and for solving tectonic problems, and (2) use of the photographs for geomorphological purposes. D.L.G.

N73-30322 Joint Publications Research Service, Arlington, Va.
TYAN-SHAN SECTION

In its Meeting of the Sov.-Am. Working Group on Remote Sensing of the Nat. Environment from Space (JPRS-59739) 8 Aug.

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1973 p 34-55 refs Transl. into ENGLISH from the publ. "Vstrecha Sovetsko-Amerikanskoy Rabochey Gruppy po Issledovaniyu Okruzhayushchey Sredy iz Kosmosa" Moscow, Acad. of Sci. USSR, 1973

The first of three selected standard sections of the USSR is dealt with. A geological outline is given of the Tyan-Shan section and the general structural features are analyzed. The Tyan-Shan section consists of the regions where the latest tectonic movements, beginning at the end of the Eocene and the beginning of the Oligocene, are clearly exhibited. The complex geological structure of the Tyan-Shan section is exemplified by the formation of three structural stages which include: (1) a lower stage that appears to be Paleozoic and pre-Paleozoic; (2) a middle stage which is made up of comparatively thin carbonaceous-argillaceous, terrigenous salt, and gypsum-bearing deposits; and (3) an upper stage corresponding to the latest orogenic step and characterized by Molasse deposits of great thickness. D.L.G.

N73-30323 Joint Publications Research Service, Arlington, Va. CAUCASIAN SECTION

In its Meeting of the Sov.-Am. Working Group on Remote Sensing of the Nat. Environment from Space (JPRS-59739) 8 Aug. 1973 p 66-72 Transl. into ENGLISH from the publ. "Vstrecha Sovetsko-Amerikanskoy Rabochey Gruppy po Issledovaniyu Okruzhayushchey Sredy iz Kosmosa" Moscow, Acad. of Sci. USSR, 1973

The Caucasian section, one of three standard sections of the USSR selected for investigation by space photography, is geographically defined and its geological structure is outlined. The investigated region encompasses the region of the extreme northeastern burial of the Greater Caucasus (from the Aladash Ridge in the north to the Alyetskaya Ridge in the south), the Kurinskaya and Araksinskaya lowlands, the northern spur of the Karabakhskiy Ridge and the Talysh Mountains. This territory is depicted on the medium-scale space photographs. Its eastern-most part directly adjacent to the Caspian Sea is also covered by the large-scale space photographs. Author

N73-30324 Joint Publications Research Service, Arlington, Va. USTYURT SECTION

In its Meeting of the Sov.-Am. Working Group on Remote Sensing of the Nat. Environment from Space (JPRS-59739) 8 Aug. 1973 p 73-92 refs Transl. into ENGLISH from the publ. "Vstrecha Sovetsko-Amerikanskoy Rabochey Gruppy po Issledovaniyu Okruzhayushchey Sredy iz Kosmosa" Moscow, Acad. of Sci. USSR, 1973

The third of three standard sections of the USSR selected for investigation by space photography is discussed. The Ustyurt section is located in the southwestern part of the epipaleozoic Turan platform. Its relatively young age is partially responsible for the sharp expression of the platform dislocations. The specific interest in the Ustyurt section is determined by its high prospectiveness for oil and gas exploration. A geological outline of the section is presented along with discussions on interpreting the lithologic-stratigraphic complexes and tectonic structure. D.L.G.

N73-30325 Joint Publications Research Service, Arlington, Va. RADAR AERIAL SURVEY AND ITS SIGNIFICANCE IN THE COMPLEMENT OF AERIAL AND SPACE GEOLOGICAL RESEARCH TECHNIQUES

V. B. Komarov, V. A. Starostin, and B. P. Nyavro In its Meeting of the Sov.-Am. Working Group on Remote Sensing of the Nat. Environment from Space (JPRS-59739) 8 Aug. 1973 p 93-106 refs Transl. into ENGLISH from the publ. "Vstrecha Sovetsko-Amerikanskoy Rabochey Gruppy po Issledovaniyu Okruzhayushchey Sredy iz Kosmosa" Moscow, Acad. of Sci. USSR, 1973 23 p

The possibilities are discussed of using the aerial radar technique for geological research. The radar aerial survey data make it possible to obtain valuable information about the structural-tectonic composition, the material composition of rocks, and the nature of the relief. Author

N73-30329 Joint Publications Research Service, Arlington, Va. GEOLOGICAL-STRUCTURAL INTERPRETATION OF PHOTOGRAPHS OF THE BALKHASH REGION FROM SPACE AND THEIR ROLE IN THE GEOLOGICAL STUDY OF CENTRAL KAZAKHSTAN

V. B. Komarov, N. V. Skublova, and N. A. Yakovlev In its Meeting of the Sov.-Am. Working Group on Remote Sensing of the Nat. Environment from Space (JPRS-59739) 8 Aug. 1973 p 152-159 refs Transl. into ENGLISH from the publ. "Vstrecha Sovetsko-Amerikanskoy Rabochey Gruppy po Issledovaniyu Okruzhayushchey Sredy iz Kosmosa" Moscow, Acad. of Sci. USSR, 1973 17 p

The geological-structural interpretation of a space photograph of the Balkhash test site (a space photograph from the Salyut satellite in June 1971) was used to outline the areas of development of terrigenous, volcanogenic and intrusive formations of the Paleozoic and Quaternary deposits of different genesis. The dislocations with a break in continuity of the northwestern, meridional, and sublatitudinal strike were revealed, including at the bottom of Balkhash Lake and in the area of development of the Mesozoic-Cenozoic, deposits more than 50 meters thick. Part of them are confirmed by geological data. In the geomorphological landscape of the test site, the peneplain and accumulation plains of different age are discriminated. The latest structure of the test site is interpreted as a dome-like uplift in the south separated by a trough from the stable region of the north shore of the Balkhash Lake. Author

N73-31292*# Argus Exploration Co., Los Angeles, Calif.

A RECONNAISSANCE SPACE SENSING INVESTIGATION OF CRUSTAL STRUCTURE FOR A STRIP FROM THE EASTERN SIERRA NEVADA TO THE COLORADO PLATEAU Progress Report, 1 Jul. - 31 Aug. 1973

Mark A. Liggett, Principal Investigator 10 Sep. 1973 8 p ERTS

(Contract NAS5-21809)

(E73-10985; NASA-CR-133764) Avail: NTIS HC \$3.00 CSCL 08G

N73-31298*# Utah Univ., Salt Lake City. Dept. of Geological and Geophysical Sciences.

GEOLOGICAL AND GEOCHEMICAL STUDIES IN THE ROBINSON MINING DISTRICT, WHITE PINE COUNTY, NEVADA, USING SKYLAB S190A IMAGERY Quarterly Report, period ending 20 Jul. 1973

M. L. Jensen, Principal Investigator, R. J. Rogers, and M. P. Erickson 1 Aug. 1973 5 p EREP

(Contract NAS9-13322)

(E73-10992; NASA-CR-133771) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. In the Robinson mining district which included the Ruth porphyry copper mines, three large positive aeromagnetic anomalies exist over a Tertiary volcanic area north west of Ruth. Prior studies of this area have suggested that the volcanics may or may not be the cause of the anomalies. Skylab S190A imagery, however, indicates possible outcrops in the volcanic area of the Paleozoic sediments. Field studies or ground truth verify the existence of these inliers suggesting that the magnetic anomaly may be the result of a buried intrusive body for which potential mineralization has been covered by the post-ore blanket of volcanics. The area is being mapped in more detail and samples of mercury-bearing soil-gas area being collected within and outside the area.

N73-31304*# California Earth Science Corp., Santa Monica. FAULT TECTONICS AND EARTHQUAKE HAZARDS IN THE PENINSULAR RANGES, SOUTHERN CALIFORNIA Monthly Progress Report, Aug. 1973

Paul M. Merifield, Principal Investigator 5 Sep. 1973 3 p EREP

(Contract NAS2-7698)

(E73-10999; NASA-CR-133780; MPR-3) Avail: NTIS HC \$3.00 CSCL 08E

N73-31305*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

APPLICATION OF SKYLAB MULTISPECTRAL PHOTOGRAPHY AND SCANNER IMAGES TO GEOLOGICAL INVESTIGATION OF THE BASIN-AND-RANGE-COLORADO PLATEAU BOUNDARY IN NORTH CENTRAL AND CENTRAL ARIZONA Progress Report, 1 Jun. - 30 Jul. 1973

Alexander F. H. Goetz, Principal Investigator 31 Aug. 1973
1 p EREP
(Contract NAS9-13394)
(E73-11000; NASA-CR-133781) Avail: NTIS HC \$3.00 CSCL 08G

N73-31308*# Stanford Univ., Calif. School of Earth Sciences.
FEASIBILITY OF USING S-191 INFRARED SPECTRA FOR GEOLOGICAL STUDIES FROM SPACE Monthly Report. 2 Aug. - 1 Sep. 1973

R. J. P. Lyon and A. A. Green, Principal Investigators 1 Sep. 1973 3 p EREP
(Contract NAS9-13357)
(E73-11003; NASA-CR-133786) Avail: NTIS HC \$3.00 CSCL 08G

N73-31315*# Colorado School of Mines, Golden. Dept. of Geology.

GEOLOGIC AND MINERAL AND WATER RESOURCES. INVESTIGATIONS IN WESTERN COLORADO, USING SKYLAB EREP DATA Monthly Progress Report, Aug. 1973
Keenan Lee, Principal Investigator 18 Sep. 1973 5 p EREP
(Contract NAS9-13394)
(E73-11010; NASA-CR-133803) Avail: NTIS HC \$3.00 CSCL 08F

N73-31324*# Geological Survey, Washington, D.C.
IRON ABSORPTION BAND ANALYSIS FOR THE DISCRIMINATION OF IRON-RICH ZONES Progress Report, 1 Jan. - 30 Jun. 1973

Lawrence C. Rowan, Principal Investigator 10 Jul. 1973 26 p refs
Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(NASA Order S-70243-AG-4)
(E73-11020; NASA-CR-133817) Avail: NTIS HC \$3.50 CSCL 08G

The author has identified the following significant results. Study has concentrated on the two primary aspects of the project, structural analysis through evaluation of lineaments and circular features and spectral analyses through digital computer-processing techniques. Several previously unrecognized lineaments are mapped which may be the surface manifestations of major fault or fracture zones. Two of these, the Walker Lane and the Midas Trench lineament system, transect the predominantly NNE-NNW-trending mountain ranges for more than 500 km. Correlation of major lineaments with productive mining districts implies a genetic relationship, the 50 circular or elliptical features delineated suggest a related role for Tertiary volcanism. Color-ratio composites have been used to identify limonitic zones and to discriminate mafic and felsic rock by combining diazo color transparencies of three different ratios. EROS Data Center scene identification number for color composite in this report is ER 1 CC 500. Refinement of enhancement procedures for the ratio images is progressing. Fieldwork in coordination with both spectral and structural analyses is underway.

N73-31327*# Geological Survey, Menlo Park, Calif.
IDENTIFICATION OF GEOSTRUCTURES OF CONTINENTAL CRUST, PARTICULARLY AS THEY RELATE TO MINERAL-RESOURCE EVALUATION Progress Report, 1 Jul. - 31 Aug. 1973

George Gryc, Principal Investigator and Ernest H. Lathram 4 Sep. 1973 3 p ERTS
(NASA Order S-70243-AG-1)
(E73-11023; NASA-CR-133820) Avail: NTIS HC \$3.00 CSCL 08G

N73-31328*# National Center for Earthquake Research, Menlo Park, Calif.

INVESTIGATION OF PROTOTYPE VOLCANO SURVEILLANCE NETWORK Progress Report, 1 Jul. - 31 Aug. 1973

Jerry P. Eaton, Principal Investigator and Peter L. Ward 1 Sep. 1973 3 p ERTS
(NASA Order S-70243-AG-2)
(E73-11024; NASA-CR-133821) Avail: NTIS HC \$3.00 CSCL 08G

N73-31329*# Geological Survey, Denver, Colo.
EVALUATION OF ERTS-1 IMAGERY FOR MAPPING QUATERNARY DEPOSITS AND LANDFORMS IN THE GREAT PLAINS AND MIDWEST Progress Report, 1 Jan. - 30 Jun. 1973

Roger B. Morrison, Principal Investigator and George R. Hallberg (Iowa Geol. Survey, Iowa City) 1 Jul. 1973 10 p ERTS
(NASA Order S-70243-AG-1)
(E73-11025; NASA-CR-133822) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. Maps of 1:1 million scale exemplifying the first phase of investigation were prepared for ten study areas (mostly 1 deg x 2 deg in area): 2 in Kansas, 1 in Missouri-Kansas, 2 in Nebraska, 1 in South Dakota, 3 in Illinois, and 1 in Iowa-Illinois (a total of 13 such maps, covering about 97,000 sq. mi., since the start of the project). Collection of all pertinent published geologic-terrain data also has been completed for all the study areas for which these first-phase maps have been made. The ground truth data are being used in combination with additional interpretation of the repetitive ERTS-1 images of most of these study areas to prepare enhanced information maps at 1:500,000. For areas that have not been mapped at 1:500,000 or larger scales, the maps will provide the first moderately detailed information on landform features and surficial materials. Much of the information mapped is significant for exploration and development of ground water (and locally petroleum) and for applications in engineering and environmental geology, and land use patterns as indicated by tone and texture on the images. Numerous moraines have been identified; also, the trends of parts of ancient filled valleys have been identified. Valley alignment appears controlled by faults or other structural lineaments.

N73-31336*# Utah Univ., Salt Lake City. Dept. of Geological and Geophysical Sciences.
FRACTURE TRENDS IDENTIFIED BY ERTS-1 IMAGERY IN UTAH AND NEVADA

Mead L. Jensen, Principal Investigator, M. P. Erickson, and M. R. Smith 24 Aug. 1973 102 p ERTS
(Contract NAS5-21883)
(E73-11032; NASA-CR-133880) Avail: NTIS HC \$7.25 CSCL 08E

The author has identified the following significant results. In the Utah-Nevada area, linear structural trends recorded on ERTS-1 imagery conform in part to previously recognized structures. In addition, the ERTS-1 imagery reveals cryptic structures not previously identified and not readily apparent in other imagery. These structures are illustrated by prominent east-west trending structures which appear to be concentrated in pre-volcanic rocks. This suggests that the structures are older than many of those with other trends which are equally prominent in volcanic and non-volcanic terrain. Since the older east-west structures may have controlled early Tertiary emplacement of magma or the ascent of mineralizing fluids, their recognition is important in mineral exploration. Soil-gas sampling and analysis for mercury content is being continued over structures, and projected trends of buried structures which appear, from studies of ERTS-1 imagery, to be favorable to mineralization. Comparison of ERTS-1 and Skylab imagery indicated that ERTS-1 imagery records more previously unrecognized linear structures than the Skylab imagery. In differentiating and identifying different rock types, the Skylab imagery appears to be more effective.

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N73-31337*# Wolf Research and Development Corp., Pocomoke City, Md.

APPLICABILITY OF SATELLITE REMOTE SENSING FOR MONITORING SURFACE MINING ACTIVITIES Quarterly Progress Report, 8 Jun. - 8 Sep. 1973

R. L. Brooks, Principal Investigator and J. D. Pennewell 24 Sep. 1973 7 p EREP

(Contract NAS9-13310)

(E73-11033; NASA-CR-133865; QPR-2) Avail: NTIS HC \$3.00 CSCL 081

N73-31338*# Indiana Geological Survey, Bloomington.
STUDY OF APPLICATION OF ERTS-A IMAGERY TO FRACTURE-RELATED MINE SAFETY HAZARDS IN THE COAL MINING INDUSTRY Significant Results Report

Charles Wier, Frank J. Wobber (Earth Satellite Corp., Washington, D. C.), Orville R. Russell, and Kenneth R. Martin, Principal Investigators 28 Sep. 1973 1 p ERTS

(Contract NAS5-21795)

(E73-11034; NASA-CR-133866) Avail: NTIS HC \$3.00 CSCL 081

The author has identified the following significant results. Mined land reclamation analysis procedures developed within the Indiana portion of the Illinois Coal Basin were independently tested in Ohio utilizing 1:80,000 scale enlargements of ERTS-1 image 1029-16361-7 (dated August 21, 1972). An area in Belmont County was selected for analysis due to the extensive surface mining and the different degrees of reclamation occurring in this area. Contour mining in this area provided the opportunity to extend techniques developed for analysis of relatively flat mining areas in Indiana to areas of rolling topography in Ohio. The analysts had no previous experience in the area. Field investigations largely confirmed office analysis results although in a few areas estimates of vegetation percentages were found to be too high. In one area this error approximated 25%. These results suggest that systematic ERTS-1 analysis in combination with selective field sampling can provide reliable vegetation percentage estimates in excess of 25% accuracy with minimum equipment investment and training. The utility of ERTS-1 for practical and reasonably reliable update of mined lands information for groups with budget limitations is suggested. Many states can benefit from low cost updates using ERTS-1 imagery from public sources.

N73-31339*# Geological Survey, Menlo Park, Calif.

IDENTIFICATION OF GEOSTRUCTURES OF CONTINENTAL CRUST, PARTICULARLY AS THEY RELATE TO MINERAL-RESOURCE EVALUATION Progress Report, 1 Jan. - 30 Jun. 1973

George Gryc, Principal Investigator and Ernest H. Lathram 30 Jun. 1973 10 p refs ERTS

(NASA Order S-70243-AG-1)

(E73-11035; NASA-CR-133881) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. Analysis of lineated lakes in the Umiat, Alaska area and comparison with known geology, gravity, and magnetic data in the area suggest concealed structures exist at depth, possibly at or near basement, which may represent targets for petroleum exploration. Compilation of reconnaissance geologic data on 1:250,000 scale enlargements of ERTS-1 images near Corwin reveal structural and stratigraphic anomalies that suggest the Cretaceous sequence is less thick than supposed and is repeated in a series of plates superimposed by flat thrust faults. The structural style differs from that in coeval strata to the north-east, across the northwest-trending linear zone separating differing tectonic styles in older strata noted earlier. The regional extension of a fault known locally in the McCarthy area has been recognized; this fault appears to form the boundary of a significant terrane of mid-Paleozoic metamorphic rocks. ERTS-1 images are being used operationally, at 1:1,000,000 scale in the compilation of regional geologic maps, and at 1:250,000 scale in field mapping in the Brooks Range, in the study of faults in seismically active

southern Alaska, in field-checking interpretations previously made from ERTS-1 imagery, and orthophoto base maps for geologic maps.

N73-31343*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

APPLICATION OF SKYLAB MULTISPECTRAL PHOTOGRAPHY AND SCANNER IMAGES TO GEOLOGICAL INVESTIGATION OF THE BASIN-AND-RANGE-COLORADO PLATEAU BOUNDARY IN NORTH CENTRAL AND CENTRAL ARIZONA Progress Report, 1-31 Aug. 1973

Alexander F. H. Goetz, Principal Investigator 25 Sep. 1973 1 p Sponsored by NASA EREP

(E73-11042; NASA-CR-133923) Avail: NTIS HC \$3.00 CSCL 08H

N73-31370# Technische Universitaet, Clausthal-Zellerfeld (West Germany). Inst. fuer Geologie und Palaeontologie.

REMOTE SENSING AS APPLIED TO GEOLOGY. POSSIBILITIES AND PROBLEMS OF GEOLOGICAL REMOTE SENSING FROM AIRCRAFT AND SATELLITE [REMOTE SENSING IN DER GEOLOGIE. MOEGLICHKEITEN UND PROBLEME DER ERDERKUNDUNG MIT HILFE VON FLUGZEUGEN UND SATELLITEN]

Reinhard Guenther Bad Godesberg, West Ger. Bundesmin. fuer Bildung und Wiss. Sep. 1972 214 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Bildung und Wiss.

(BMFW-FB-W-72-28) Avail: NTIS HC \$12.75; ZDI. Munich 44,55 DM

Parameters and application potential of remote sensing methods are presented, such as photography, infrared and multispectral scanning, TV imaging, side-looking radar, spectral photometry, and ultraviolet techniques. The kind and number of parameters affecting the signal were emphasized. The methods of data processing are outlined, including contrast enhancement and computer processing.

Author (ESRO)

N73-32218*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

AN INTERDISCIPLINARY ANALYSIS OF COLORADO ROCKY MOUNTAIN ENVIRONMENTS USING ADP TECHNIQUES Bimonthly Progress Report, 1 Jul. - 31 Aug. 1973

Roger M. Hoffer, Principal Investigator 31 Aug. 1973 17 p ref ERTS

(Contract NAS5-21880)

(E73-11039; NASA-CR-133885) Avail: NTIS HC \$3.00 CSCL 08E

N73-32220*# Southern Illinois Univ., Carbondale. Dept. of Anthropology.

THE HYDROLOGY OF PREHISTORIC FARMING SYSTEMS IN A CENTRAL ARIZONA ECOTONE Quarterly Report

George J. Gumerman, Principal Investigator 26 Sep. 1973 6 p Prepared in cooperation with Prescott Coll., Ariz. EREP

(Contract NAS9-13342)

(E73-11044; NASA-CR-133929) Avail: NTIS HC \$3.00 CSCL 08H

N73-32223*# Colorado School of Mines, Golden. Dept. of Geology.

GEOLOGIC AND MINERAL AND WATER RESOURCES INVESTIGATIONS IN WESTERN COLORADO Progress Report 1 Aug. - 31 Sep. 1973

Daniel H. Knepper, Jr., Principal Investigator and Stephen M. Nicolais 30 Sep. 1973 3 p ERTS

(Contract NAS5-21778)

(E73-11047; NASA-CR-133931) Avail: NTIS HC \$3.00 CSCL 08F

N73-32225*# Iowa Univ., Iowa City.

UTILIZING ERTS-1 IMAGERY FOR TECTONIC ANALYSIS THROUGH STUDY OF THE BIGHORN MOUNTAINS REGION Progress Report, 16 Mar. - 15 Sep. 1973

Richard A. Hoppin, Principal Investigator 15 Sep. 1973 9 p
ERTS
(Contract NAS5-21852)
(E73-11049; NASA-CR-133870) Avail: NTIS HC \$3.00 CSCL
08G

The author has identified the following significant results. Comparisons of imagery of three seasons, late summer-fall, winter, and spring indicate that for this region fall imagery is the best for overall geologic analysis. Winter scenes with light to moderate snow cover provide excellent topographic detail owing to snow enhancement, lower sun angle, and clarity of the atmosphere. Spring imagery has considerable reduction of tonal contrast owing to the low reflecting heavy green grass cover which subdues lithologic effects; heavy snow cover in the uplands masks topography. Mapping of geologic formations is impractical in most cases. Separation into tonal units can provide some general clues on structure. A given tonal unit can include parts of several geologic formations and different stratigraphic units can have the same tonal signature. Drainage patterns and anomalies provide the most consistent clues for detecting folds, monoclines, and homoclines. Vegetation only locally reflects lithology and structure. False color infrared 9 x 9 transparencies are the most valuable single imagery. Where these can be supplemented by U-2 color infrared for more detailed work, a tremendous amount of information is available. Adequately field checking such a large area just in one scene is the major logistic problem even in a fairly well known region.

N73-32229* Eason Oil Co., Oklahoma City, Okla.
AN EVALUATION OF THE SUITABILITY OF ERTS DATA FOR THE PURPOSES OF PETROLEUM EXPLORATION
Progress Report, Jun. - Jul. 1973
Robert J. Collins, Principal Investigator 1 Oct. 1973 2 p
ERTS
(Contract NAS5-21735)
(E73-11053; NASA-CR-133934) Avail: NTIS HC \$3.00 CSCL
08G

N73-32232* Pennsylvania State Univ., University Park. Office for Remote Sensing of Earth Resources (ORSER).
INTERDISCIPLINARY APPLICATION AND INTERPRETATION OF EREP DATA WITHIN THE SUSQUEHANNA RIVER BASIN Quarterly Progress Report, Jun. - Aug. 1973
George J. McMurtry, Principal Investigator Sep. 1973 2 p
EREP
(Contract NAS9-13406)
(E73-11056; NASA-CR-133946) Avail: NTIS HC \$3.00 CSCL
08H

N73-32247* Geological Survey, Denver, Colo.
REMOTE SENSING GEOPHYSICS FROM SKYLAB Status Report, Sep. 1973
Kenneth Watson, Principal Investigator Sep. 1973 2 p EREP
(NASA Order T-6555-B)
(E73-11072; NASA-CR-135541) Avail: NTIS HC \$3.00 CSCL
08E

N73-32271* Minnesota Univ., Minneapolis. Dept. of Geology.
A PROPOSAL FOR PRECAMBRIAN MINERAL RESOURCE EVALUATION IN MINNESOTA UTILIZING ERTS IMAGERY
Donald Davidson, Jr. In its A study of Minn. Forests and Lakes using Data from ERTS 30 Jun. 1973 p 86-87

CSCL 08G

An investigation was made of Minnesota. These rock units hold promise for potential mineral resources as do important ore deposits found in similar rocks to the north in Canada. The research planned involves the discrimination of rock types to show their aerial extent and an interpretation of the structural relationships between and within the various rock units. Author

N73-32279* Colorado School of Mines, Golden. Dept. of Geology.
REMOTE SENSING AIDS GEOLOGIC MAPPING
Daniel H. Knepper, Jr. and Ronald W. Marrs Oct. 1972 11 p

refs Repr. from Proc. of the 8th Intern. Symp. on Remote Sensing of Environment p 1127-1136
(Grant NGL-06-001-015)
(NASA-CR-135636; Rept-72-8) Avail: NTIS HC \$3.00 CSCL
08G

Remote sensing techniques were applied to general geologic mapping along the Rio Grande rift zone in central Colorado. A geologic map of about 1,100 square miles was prepared utilizing (1) prior published and unpublished maps, (2) detailed and reconnaissance field maps made for this study, and (3) remote sensor data interpretations. The map is used for interpretation of the complex Cenozoic tectonic and geomorphic histories of the area. Author

N73-33247* Rockwell International Science Center, Thousand Oaks, Calif.
IDENTIFICATION AND INTERPRETATION OF TECTONIC FEATURES FROM ERTS-A IMAGERY Progress Report, 1 Aug. - 30 Sep. 1973
Monem Abdel-Gawad, Principal Investigator 6 Oct. 1973 4 p
ref ERTS
(Contract NAS5-21767)
(E73-11084; NASA-CR-135552) Avail: NTIS HC \$3.00 CSCL
08E

N73-33253* Environmental Research Inst. of Michigan, Ann Arbor.
SPECTRAL RATIO IMAGING METHODS FOR GEOLOGICAL REMOTE SENSING FROM AIRCRAFT AND SATELLITES
Robert K. Vincent, Principal Investigator Oct. 1973 22 p refs
Presented at the Management Utilization of Remote Sensing Data Conf., Sioux Falls, S. D., 31 Oct. 1973; sponsored by Am. Soc. of Photogrammetry Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(Contracts NAS5-21783; NAS9-9784; DI-BM-HO-210041)
(E73-11096; NASA-CR-135564) Avail: NTIS HC \$3.25 CSCL
08G

The author has identified the following significant results. The production of ratio images from multispectral scanner data is described and several examples of ratio images from aircraft and ERTS-1 data are given for visible, reflective infrared, and thermal infrared wavelengths. The application of photogrammetric techniques to ratio images, defined for this paper as ratio scannergrammetry, is considerably aided by the lesser dependence of ratio images on atmospheric and solar illumination variations, compared with single channel scanner imagery or aerial photos. Ratio scannergrammetry is further aided by the proportionality between ratios of a target deduced from ratio images and ratios of reflectances calculated from laboratory spectra of samples from the target area. Consequently, ratios calculated from laboratory data can be used to predict which ratios are best for discriminating a given rock or mineral, to predict what other rocks or minerals will be confused with it, and finally, to place ratio scannergrammetry on an absolute basis, within an estimated standard error on the order of 5% to 10%. Examples of relative agreement between laboratory data and ratio images are given from two iron oxides, hematite and magnetite.

N73-33257* Geological Survey, Denver, Colo. 08g
THERMAL SURVEILLANCE OF ACTIVE VOLCANOES
Progress Report, 1 Apr. - 30 Jun. 1973
Jules D. Friedman, Principal Investigator 30 Jun. 1973 4 p
ref ERTS
(NASA Order S-70243-AG)
(E73-11100; NASA-CR-135569) Avail: NTIS HC \$3.00

The author has identified the following significant results. There are three significant scientific results of the discovery of 48 pinpoint anomalies on the upper flanks of Mt. Rainier: (1) Many of these points may actually be the location of fumarolic vapor emission or warm ground considerably below the summit crater. (2) Discovery of these small anomalies required specific V/H scanner settings for precise elevation on Mt. Rainier's flank, to avoid smearing the anomalies to the point of nonrecognition. Several past missions flown to map the thermal anomalies of the summit area did not detect the flank anomalies. (3) This illustrates the value of the aerial IR scanner as a geophysical

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tool suited to specific problem-oriented missions, in contrast to its more general value in a regional or reconnaissance anomaly-mapping role.

N73-33264*# Pennsylvania State Univ., University Park. Office for Remote Sensing of Earth Resources (ORSER).

MAPPING OF ANTHRACITE REFUSE Interim Report
George J. McMurtry, Gary W. Petersen, Principal Investigators,
D. N. Thompson, and F. Y. Borden May 1973 18 p refs
ERTS

(Contract NAS5-23133)

(E73-11107; NASA-CR-135575; ORSER-SSEL-TR-20-73) Avail:
NTIS HC \$3.00 CSCL 08B

N73-33281*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

MAPPING OF THE MAJOR STRUCTURES OF THE AFRICAN RIFT SYSTEM USING ERTS-1 Progress Report, 1 Jan. - 30 Jun. 1973

Paul A. Mohr, Principal Investigator Oct. 1973 2 p ERTS

(Contract NAS5-21748)

(E73-11126; NASA-CR-135664) Avail: NTIS HC \$3.00 CSCL 08B

N73-33282*# Wyoming Univ., Laramie. Remote Sensing Lab.
RECONNAISSANCE GEOLOGIC MAPPING IN THE DRY VALLEYS OF ANTARCTICA USING THE EARTH RESOURCES TECHNOLOGY SATELLITE Special Report

Robert S. Houston, Principal Investigator, Frank W. Zochol, and Scott B. Smithson 5 Aug. 1973 33 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21818)

(E73-11127; NASA-CR-135665; ERTS-ANT-S-73A) Avail:
NTIS HC \$3.75 CSCL 08B

The author has identified the following significant results. Reconnaissance geologic mapping can be done with 60-70% accuracy in the Dry Valleys of Antarctica using ERTS-1 imagery. Bedrock geology can be mapped much better than unconsolidated deposits of Quaternary age. Mapping of bedrock geology is facilitated by lack of vegetation, whereas mapping of Quaternary deposits is hindered by lack of vegetation. Antarctic images show remarkable clarity and under certain conditions (moderate relief, selection of the optimum band for specific rock types, stereo-viewing) irregular contacts can be mapped in local areas that are amazing like those mapped at a scale of 1:25,000, but, of course, lack details due to resolution limitations. ERTS-1 images should be a valuable aid to Antarctic geologists who have some limited ground truth and wish to extend boundaries of geologic mapping from known areas.

N73-33285*# Colorado School of Mines, Golden. Dept. of Geology.

GEOLOGIC AND MINERAL AND WATER RESOURCES INVESTIGATIONS IN WESTERN COLORADO, USING SKYLAB EREP DATA Monthly Progress Report, Sep. 1973
Keenan Lee, Principal Investigator and Daniel H. Knepper, Jr. 19 Oct. 1973 5 p EREP

(Contract NAS9-13394)

(E73-11130; NASA-CR-135677) Avail: NTIS HC \$3.00 CSCL 08F

N73-33286*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

APPLICATION OF ERTS AND EREP IMAGES TO GEOLOGIC INVESTIGATIONS OF THE BASIN AND RANGE - COLORADO PLATEAU BOUNDARY IN NORTHWESTERN AND NORTH-CENTRAL ARIZONA Progress Report, 15 Jun. - 15 Aug. 1973

A. F. H. Goetz, Principal Investigator, F. C. Billingsley, D. P. Elston, I. Lucchitta, and E. M. Shoemaker 15 Oct. 1973 2 p
Prepared in cooperation with Geol. Survey, Flagstaff, Ariz. and Calif. Inst. of Tech., Pasadena Sponsored by NASA ERTS
(E73-11131; NASA-CR-135678) Avail: NTIS HC \$3.00 CSCL 08G

N73-33289*# California Earth Science Corp., Santa Monica.
FAULT TECTONICS AND EARTHQUAKE HAZARDS IN THE PENINSULAR RANGES, SOUTHERN CALIFORNIA Monthly Progress Report

Paul M. Merfield, Principal Investigator 5 Oct. 1973 3 p EREP

(Contract NAS2-7698)

(E73-11134; NASA-CR-135681; MPR-4) Avail: NTIS HC \$3.00 CSCL 08K

N73-33291*# Wyoming Univ., Laramie. Dept. of Geology.
MULTIDISCIPLINARY STUDY OF WYOMING TEST SITES Progress Report, Jul. - Sep. 1973

Robert S. Houston, Principal Investigator and Ronald W. Marrs 10 Oct. 1973 9 p EREP

(Contract NAS9-13298)

(E73-11136; NASA-CR-135683; EREP-1-73) Avail: NTIS HC \$3.00 CSCL 05B

The author has identified the following significant results. Comparisons between ERTS-1 and EREP 70 mm images revealed that the EREP S-190A imagery is superior to ERTS-1 in spatial resolution but lacks tonal fidelity. However, tests of the S-192 screening film indicate that it will provide the necessary tonal fidelity for color additive work. No resolution comparisons were made with the S-192 imagery because the screening film, the only S-192 data currently available, does not represent an optimum quality product. Correlative ground truth data and aircraft imagery have been gathered for each of the EREP data passes. These data will not only serve as a primary means of calibrating EREP data and checking interpretations, but also aid in making decisions about optimum band combinations for S-190A and S-192.

N73-33295*# South Carolina State Development Board, Columbia.

APPLICATION OF MULTISPECTRAL PHOTOGRAPHY TO MINERAL AND LAND RESOURCES OF SOUTH CAROLINA Quarterly Progress Report

Norman K. Olson, Principal Investigator 15 Oct. 1973 4 p EREP

(Contract NAS8-29617)

(E73-11140; NASA-CR-135699; QPR-2) Avail: NTIS HC \$3.00 CSCL 08G

N73-33302*# Indiana Geological Survey, Bloomington. Coal Section.

APPLICATION OF EREP IMAGERY TO FRACTURE-RELATED MINE SAFETY HAZARDS AND ENVIRONMENTAL PROBLEMS IN MINING Quarterly Progress Report, 20 Jul. - 20 Oct. 1973

Charles E. Wier, Frank J. Wobber, Roger V. Amato, and Orville R. Russell, Principal Investigators 22 Oct. 1973 8 p Prepared in cooperation with Earth Satellite Corp., Washington, D. C. EREP

(Contract NAS9-13358)

(E73-11148; NASA-CR-135736) Avail: NTIS HC \$3.00 CSCL 08I

The author has identified the following significant results. Numerous fracture traces were detected on both the color transparencies and black and white spectral bands. Fracture traces of value to mining hazards analysis were noted on the EREP imagery which could not be detected on either the ERTS-1 or high altitude aircraft color infrared photography. Several areas of mine subsidence occurring in the Busseron Creek area near Sullivan, Indiana were successfully identified using color photography. Skylab photography affords an increase over comparable scale ERTS-1 imagery in level of information obtained in mined lands inventory and reclamation analysis. A review of EREP color photography permitted the identification of a substantial number of non-fuel mines within the Southern Indiana test area.

A new mine was detected on the EREP photography without prior data. EREP has definite value for estimating areal changes in active mines and for detecting new non-fuel mines. Gob piles and slurry ponds of several acres could be detected on the S-190B color photography when observed in association with large scale mining operations. Apparent degradation of water quality resulting from acid mine drainage and/or siltation was noted in several ponds or small lakes and appear to be related to intensive mining activity near Sullivan, Indiana.

N73-33305*# Iowa Univ., Iowa City. Dept. of Geology.
**EXPERIMENT TO EVALUATE FEASIBILITY OF UTILIZING
 SKYLAB-EREP REMOTE SENSING DATA FOR TECTONIC
 ANALYSIS OF THE BIGHORN MOUNTAINS REGION,
 WYOMING-MONTANA** Quarterly Progress Report, 1 Jul. -
 30 Sep. 1973

Richard A. Hoppin, Principal Investigator 19 Oct. 1973 5 p
 EREP

(Contract NAS9-13313)

(E73-11151; NASA-CR-135739) Avail: NTIS HC \$3.00 CSCL
 08G

The author has identified the following significant results. Excellent imagery has been obtained from SL-3 along track 5 across the Bighorn Mountains and track 19 across the northern Black Hills. The red band is by far the best of the four black and white films of S-190A. Excellent detail is visible of topography, structure, resistant lithologies, and culture with good resolution obtainable at high magnification (30X). The infrared bands do not have as good resolution and are grainy at high magnification. They are of use as a complement to the red band particularly for relief enhancement in areas of heavy green grass and forest cover. S-190B high definition black and white is comparable to the red band (S-190A) in detail. Its main advantage is larger initial scale and slightly better resolution. High resolution color transparencies along track 19 allow detailed delineation of cultivated land and strip mining. A group of folds northwest of Billings stand out clearly. Light colored units in northwestern Black Hills and in the badlands can be mapped in great detail.

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OCEANOGRAPHY AND MARINE RESOURCES

Includes sea-surface temperature, ocean bottom surveying imagery, drift rates, sea ice and icebergs, sea state, fish location.

A70-18582 *

ON THE ELECTRICAL NATURE OF WATERSPOUTS.

Vernon J. Rossow (NASA, Ames Research Center, Moffett Field, Calif.).

IN: THUNDERSTORMS AND THUNDERSTORM PHENOMENA; AMERICAN METEOROLOGICAL SOCIETY, CONFERENCE ON SEVERE LOCAL STORMS, 8TH, CHICAGO, ILL., APRIL 8-10, 1969, PREPRINTS.

Boston, American Meteorological Society, 1969, p. 182-187.

The electric and magnetic fields of a number of waterspouts in the Key West, Fla. area have been measured by an instrumented U.S. Navy aircraft. It was found that electricity did not play a role in the structure of these events. Various features of these atmospheric vortices are described and illustrated. (Author)

A70-18592

REMOTE SENSING OF OCEAN COLOR.

James S. Bailey and Peter G. White (TRW Systems Group, Redondo Beach, Calif.).

IN: INSTRUMENT SOCIETY OF AMERICA, ANNUAL CONFERENCE, 24TH, HOUSTON, TEX., OCTOBER 27-30, 1969, PROCEEDINGS.

Pittsburgh, Instrument Society of America (Advances in Instrumentation. Volume 24. Part 3), 1969, p. 635 1-635 7.

Instruments for quickly and objectively measuring and mapping ocean color variations have been developed and tested. The Wide-range Image Spectrophotometer (WISP) and the Water Color Spectrometer (WCS) utilize some entirely new concepts conceived and developed at TRW Systems. The measurement of ocean color variations, particularly by means of remote sensors provides an economical means of delineating ocean water masses and other properties within a time frame commensurate with a dynamic medium. The WCS produces a continuous record of the spectral distribution of light energy coming from the ocean in only one spatial element while the WISP is designed to measure simultaneously the color over many spatial elements. Examples of WCS data are shown in unreduced and reduced form of various water colors. An example of water with and without an oil film is also shown. WISP data are shown in reduced form only. The WISP examples are also of various water colors and water with and without an oil film. (Author)

A70-18593

SOME TIME AND SPACE RESOLUTION REQUIREMENTS FOR SPACE OCEANOGRAPHY.

Robert E. Stevenson (U.S. Department of the Interior, Bureau of Commercial Fisheries, Galveston, Tex.).

IN: INSTRUMENT SOCIETY OF AMERICA, ANNUAL CONFERENCE, 24TH, HOUSTON, TEX., OCTOBER 27-30, 1969, PROCEEDINGS.

Pittsburgh, Instrument Society of America (Advances in Instrumentation. Volume 24. Part 3), 1969, p. 636 1-636 4. 7 refs.

Analyses of photographs from manned space flights and the related oceanography have led to determinations of the spatial resolution and intervals of repetition necessary for the optimum utilization of space-derived, remotely sensed data of certain ocean-surface features. Coastal waters, both continental and insular, place the greatest demands on the space system. In these inshore waters, ocean-surface features of 25 square kilometers or larger must be

viewed once every 24 hours, on a temperature grid of 10 kilometers, with a feature-boundary definition of 100 meters. These requirements must be applied only to precise geographic localities, if excessive data handling is to be avoided. Coastal eddies that form sequences of von Kármán vortices are examples of ocean-surface features that have periods, sizes, and sufficient energy to contribute significantly to local environments. A cost-benefit study of three submarine outfalls that carry 1 billion gallons of sewage to the sea indicated a \$1 million per year advantage if daily data were available on the near-shore eddy system. (Author)

A70-18957

REMOTE-SENSOR APPLICATIONS IN FISHERY RESEARCH.

Paul M. Maughan (Bureau of Commercial Fisheries, Washington, D.C.).

Marine Technology Society Journal, vol. 3, Mar. 1969, p. 11-20. 34 refs.

Examination of the application of remote sensors to fishery research in terms of the direct and indirect detection of fish. Aerial photography and fish oil identification by spectroscopy form the basic information for the direct detection method. Gemini photography has provided the data for the indirect detection method, that is, the delineation of ocean phenomena associated with fish concentrations. M.M.

A70-22014

Oceanography from space and aircraft: State of the art—Technology/applications. Evelyn Sinha. La Jolla, Calif., Ocean Engineering Information Service (Ocean Engineering Information Series. Volume 2), 1970. 80 p. \$15.

This publication presents 428 informative abstracts which provide direct references to literature sources representing the state-of-the-art in the technology and applications of oceanography from space and aircraft. Passive and active sensing devices and techniques utilizing the infrared, microwave, and ultraviolet are reported with applications in biology and fisheries, coastal zone engineering and resources, geodesy, geology, geophysics, ice surveillance, interaction between ocean and atmosphere, marine meteorology, navigation and communication, oceanology, pollution detection, and salvage operations. Geophysical devices are related to exploration potentials. The importance of the uses of transponding buoys and telemetry is suggested. References are also given to problems involved in data processing and in computer programming. G.R.

A70-22250 *

Spectra of backscattered light from the sea obtained from aircraft as a measure of chlorophyll concentration. George L. Clarke, Gifford C. Ewing, and Carl J. Lorenzen (Woods Hole Oceanographic Institution, Woods Hole, Mass.). *Science*, vol. 167, Feb. 20, 1970, p. 1119-1121. 20 refs. Contracts No. NAS 12-631; No. Nonr-241.

Spectra of sun and skylight backscattered from the sea were obtained from a low-flying aircraft and were compared with measurements of chlorophyll concentration made from shipboard at the same localities and at nearly the same times. Increasing amounts of chlorophyll were found to be associated with a relative decrease in the blue portion of the spectra and an increase in the green. Anomalies in the spectra show that factors other than chlorophyll also affect the water color in some instances; these factors include other biochromes, suspended sediment, surface reflection, polarization, and air light. (Author)

A70-22869

Remote sensing of the sea conditions with microwave radiometer systems. J. C. Aukland, P. J. Caruso, Jr., and W. H. Conway (Spectran, Inc., Downey, Calif.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting*, Annapolis, Md., Mar. 2-4, 1970, Paper 70-318. 9 p. Members, \$1.00; nonmembers, \$1.50.

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Consideration of microwave radiometric techniques, recently developed to provide continuous all-weather monitoring of sea conditions from satellites. Ground-based measurements indicate that foam and surface ripple must be considered in any system measuring sea state or sea temperature. The presence of foam significantly modifies the radiometric temperature, depending on the quantity of foam in the beam. The measurements further point out the need for airborne measurements to generate curves for sea state determination. F.R.L.

A70-22877 # Worldwide oceanic wind and wave predictions using a satellite radar radiometer. Richard K. Moore (Kansas, University, Lawrence, Kan.) and Willard J. Pierson, Jr. (New York University, Bronx, N.Y.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-310*. 12 p. 29 refs. Members, \$1.00; nonmembers, \$1.50.

Results of radar observations of backscatter from the sea, made by NASA aircraft flying over the North Atlantic in March of 1968 and 1969, in order to establish wind speed dependence of sea echo over the range from near-calm to storm conditions. The dependence of the scattering coefficient at 2.25 cm wavelength on windspeed is shown, and its value in wave spectrum prediction is estimated. A set of observations for 75 cm wavelength is also presented, which indicates that this wavelength is unsuitable for sea-surface wind determination. Attention is given to results obtained at the same time by a microwave radiometer operated by Nordberg of NASA. A system using a satellite-borne radar-radiometer is described. The system uses the same receiver for both radar and radiometer, and a time-sharing scheme between radar transmission, radar and radiometer reception, and radiometer calibration. F.R.L.

A70-22880 # Oceanographic applications and limitations of satellite remote sensors. Robert E. Stevenson (U.S. Bureau of Commercial Fisheries, Galveston, Tex.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-306*. 4 p. 14 refs. Members, \$1.00; nonmembers, \$1.50.

Discussion of studies and evaluations of space oceanographic applications since 1965 which have resulted in the following estimates of resolution requirements: (1) temperature to about 1 deg C; (2) spatial interval to 10 sq km near islands, coasts, and current boundaries, and 500 sq km in the open ocean; (3) roughness patterns outlining surface features as small as 25 sq km; (4) repetition intervals of 24 hr near coasts and 5 days over the open ocean; (5) wave heights to 5 m; (6) wind speeds to 15 m per sec; (7) surface-feature resolution of 100 m; and (8) surface color resolution of 1,000 m. It is noted that these resolution requirements are within the apparent capabilities of earth-orbital sensor systems. M.M.

A70-22884 * # Satellite infrared observation of arctic sea ice. James C. Barnes, David T. Chang, and James H. Willand (Allied Research Associates, Inc., Concord, Mass.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-301*. 7 p. 9 refs. Members, \$1.00; nonmembers, \$1.50. NASA-supported research; Contract No. N 62306-68-C-0276.

The application of High Resolution Infrared (HRIR) imagery from the Nimbus satellites for mapping arctic sea ice is evaluated. Included are analyses of nighttime and daytime data in both film-strip and digitized format. The results indicate that nighttime HRIR imagery is an effective means of mapping sea ice distributions, particularly large-scale features. Since infrared detection of sea ice is dependent on temperature contrast, boundaries between thick, solid ice and open water can be mapped more reliably than boundaries of new or broken ice. Daytime HRIR measurements, when used in conjunction with radiometric measurements in other spectral

intervals, provide unique signatures for geophysical features. It appears that these signatures may be useful in the development of automatic analysis techniques for mapping ice distributions. (Author)

A70-23350 * Airborne fluorometer applicable to marine and estuarine studies. George E. Stoertz, William R. Hemphill (U.S. Geological Survey, Washington, D.C.), and David A. Markle (Perkin-Elmer Corp., Norwalk, Conn.). *Marine Technology Society Journal*, vol. 3, Nov.-Dec. 1969, p. 11-26. 16 refs. Research supported by the U.S. Geological Survey and NASA.

An experimental Fraunhofer line discriminator detected solar-stimulated yellow fluorescence (5890 Å) emitted by Rhodamine WT dye in aqueous solutions. Concentration of 1 part per billion was detected in tap water 1/2-meter deep. In extremely turbid San Francisco Bay, dye was monitored in concentrations of less than 5 parts per billion from helicopter and ship. Applications include studies of current dynamics and dispersion. Potential applications of the technique could include sensing oil spills, fish oils, lignin sulfonates, other fluorescent pollutants, and chlorophyll fluorescence. (Author)

A70-23756 Ocean and water surface temperature measurements using infrared remote sensing techniques. Fred W. Stang (Barnes Engineering Co., Santa Clara, Calif.). In: *Photo-optical instrumentation applications and theory; Society of Photo-optical Instrumentation Engineers, Annual Technical Symposium and Exhibition, 14th, San Francisco, Calif., August 11-14, 1969, Proceedings. Volume 2.* Symposium co-sponsored by the U.S. Army and the U.S. Air Force. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1969, p. 77-83.

Discussion of techniques for rapidly measuring sea surface temperatures over large areas to an absolute accuracy of better than 0.5 to 1.0 C. This is accomplished with the aid of highly sensitive and rugged infrared radiometers used in airborne platforms. The infrared physics and principles of infrared radiometry utilizing the Model PRT-5 precision radiation thermometer are described. Examples are given of a variety of measured sea surface temperature patterns, coastal patterns, and thermal pollution. Limitations of measurement accuracy and some methods of data correction are reviewed. F.R.L.

A70-24148 An aerial photographic survey of coastal erosion. Donald B. Stafford (Clemson University, Clemson, S.C.) and Jay Langfelder (North Carolina State University, Raleigh, N.C.). In: *American Society of Photogrammetry, Annual Meeting, 36th, Washington, D.C., March 1-6, 1970, Technical Papers.*

Falls Church, Va., American Society of Photogrammetry, 1970, p. 533-558. 15 refs.

A description of a procedure to utilize existing aerial photographs to conduct a survey of coastal erosion is presented. Briefly, the procedure consists of selecting stable reference points on aerial photographs taken in different years and measuring the distances between these points and points on the transient beach. The measurements obtained are multiplied by the scale of the aerial photographs to produce ground distances. The differences in ground distances determined from aerial photographs taken with several years of time lapse represent the change in location of the beach over the period of the time lapse. The several important advantages and the limitations of the aerial photographic approach are discussed. The use of the aerial photographic study procedure in a survey of coastal erosion along the North Carolina coast is also briefly described and illustrations are given of the type of erosion data obtained. (Author)

A70-24749 Airphoto analysis of ocean outfall dispersion. Wesley James and Fred J. Burgess (Oregon State University, Corvallis, Ore.). In: *American Society of Photogrammetry, Annual*

Meeting, 36th, Washington, D.C., March 1-6, 1970, Technical Papers. Falls Church, Va., American Society of Photogrammetry, 1970, p. 559-582. Research supported by the Federal Water Pollution Control Administration.

Aerial photography provides a method of analyzing dispersion of wastes that are discharged into the ocean. The procedures involved in determining waste concentrations from aerial photography are described. This technique is more comprehensive than conventional boat sampling in dispersion studies. Discrepancies between boat concentrations and photo concentrations are due primarily to the changing and shifting of the waste in this dynamic environment. The photographic technique presents a method of study that will provide information on diffusion which has been impossible to measure by conventional sampling methods. (Author)

A70-26903 # Remote sensing of the sea conditions with microwave radiometer systems. J. C. Auckland, P. J. Caruso, Jr., W. H. Conway (Microwave Sensor Systems, Inc., Downey, Calif.), and R. G. Groshans (RCA, Princeton, N.J.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 2. Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 709-719.

Description of a microwave radiometric experimental program the purpose of which was to generate curves relating sea state and sea-surface temperature to apparent radiometric temperatures, providing the basic data to be used with remote microwave radiometric measurements for determining sea state and sea-surface temperature. The experimental program consists of two types of measurements. The first experiments are a series of measurements on several closely controlled or monitored environments, such as water tanks and local piers. The results of the tank measurements may be used to establish the relationship between apparent radiometric and actual thermometric sea-surface temperature as a function of frequency, viewing angle, and signal polarity. The results of the pier or tower measurements may be used to obtain qualitative relationships between radiometric measurements and sea state. Following these measurements, a series of aircraft measurements coincident with ground truth measurements will provide sea state data curves in an actual ocean environment. The results of the analysis for various aircraft altitudes can then be extrapolated to produce corresponding curves for satellite altitudes. The ground-based measurements indicate that foam and surface ripple must be considered in any system measuring sea state or sea temperature. The presence of foam significantly modifies the radiometric temperature by 20 to 100 deg, depending on the quantity of foam in the beam. The measurements further point out the need for airborne measurements to generate curves for sea state determination. M.M.

A70-26904 # The remote sensing of the sea and sea ice. N. W. Guinard (U.S. Navy, Naval Research Laboratory, Washington, D.C.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings.

A70-26905 # Oceanographic applications of remote sensing with passive microwave techniques. A. T. Edgerton and D. T. Trexler (Aerojet-General Corp., El Monte, Calif.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 2. Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 767-788. 8 refs.

Discussion of passive remote sensing in the microwave spectral region which has proved to be a useful tool for determining

oceanographic phenomena such as sea state, pollution, and sea ice characteristics. Differences in radiometric brightness temperature of the sea surface on the order of 15 deg K have been readily detected during airborne measurements of the Salton Sea, California, and the North Atlantic using scanning phased array radiometers. Prediction of sea state by microwave brightness temperature is correlatable with theoretical models for sea states less than 4. Above sea state 4, white capping and the possibility of spray increase. The effects of foam on sea surface brightness temperature for a calm sea were investigated under controlled conditions. The brightness temperature for a sea surface with 50% foam cover increased approximately 40 deg K above temperatures recorded for the same surface without foam. Oil base pollutants on the ocean surface radically affect the radiometric response because of the distinctly different dielectric properties of the oil as compared to water. Laboratory and field investigations have examined the effects of different density oils and varying thicknesses on the microwave brightness temperature of the sea surface. Salinity variations in sea water between 30,000 and 35,000 ppm appear to be detectable with long wavelength radiometers. Theoretical studies indicate that small changes in the dissolved solid concentration in sea water can be determined by using radiometers operating at wavelengths greater than 10 cm. M.M.

A70-26906 # The effect of sea roughness on the bandwidth of radar backscatter. Donald L. Hammond (U.S. Navy, E. O. Hulburt Center for Space Research, Washington, D.C.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 2.

Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 797-806.

The Doppler signals of an eight millimeter aircraft radar navigation system were analyzed to determine the effect of sea roughness on the bandwidth of the radar backscatter. The ground truth giving the wave heights were obtained by estimates made by the scientist aboard the aircraft and hind-cast of the sea conditions based on weather records. The results are given in terms of a factor called 'Q' which varies inversely with bandwidth and is independent of aircraft altitude and velocity. When the data are arranged in the order of increasing wave heights, there is a trend of decreasing 'Q' with increasing wave height. (Author)

A70-26915 * # Remote measurement of ocean color as an index of biological productivity. George L. Clarke, Gifford C. Ewing, and Carl J. Lorenzen (Woods Hole Oceanographic Institution, Woods Hole, Mass.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 2.

Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 991-1001. Contract No. NAS 12-631.

Discussion of experiments performed with an airborne spectrometer in which it proved possible to distinguish ocean areas containing low to moderate chlorophyll concentrations from flight altitudes up to 10,000 ft. The data obtained indicate that the spectral effects of increased chlorophyll concentration are very nonlinear. The color of clear ocean water is 470 nm where the absorption is minimal. With added amounts of chlorophyll, the amount of water remains constant, the band of minimum absorption, and hence the color, approaches asymptotically to the wavelength of minimum absorption of chlorophyll at 560 nm. Consequently, most of the color shift occurs as a result of the addition of the first 2 or 3 mg/cb m of chlorophyll to clear sea water. The results obtained indicate that remote sensing from aircraft and satellites of small concentrations of chlorophyll shows promise of providing a unique tool for rapid monitoring of the biological productivity of the sea. V.P.

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A70-26916 # Water depth determinations using remote sensing techniques. F. C. Polcyn and I. J. Sattinger (Michigan, University, Ann Arbor, Mich.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 2. Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 1017-1028. Contract No. N 62306-67-C-0243.

Discussion of research work being conducted in order to remove doubtful soundings from navigation charts by means of remote sensing from aircraft. Several methods of determining water depth by remote sensing techniques are described. These are (1) multispectral processing using the differences in the attenuation of light at several wavelengths in the visible region, (2) analysis of wave refraction phenomena by optically generated Fourier transforms, and (3) the use of laser pulse ranging systems. A mathematical model for calculating depth on the basis of data from a multispectral scanner is described which takes into account water transmission, bottom reflection, sensor parameters, and illumination characteristics. (The accuracy and depth limits of the technique are being tested using data collected in the Florida Keys.) Changes in water wavelengths as the water goes from deep to shallow regions give an indication of depth, and is suggested as a useful technique for coastal waters where light transmission is a limiting factor. V.P.

A70-26917 # Enhanced oceanographic imagery. Donald S. Ross (Philco-Ford Corp., Space and Re-Entry Systems Div., Palo Alto, Calif.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 2. Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 1029-1044.

Survey of recent experimental results which help to increase the spectral information content of aerial photo imagery as a source of major data for discovery and utilization of earth resources and related scientific phenomena. Apollo 9 space photographs are presented which show that useful images of oceanographic subjects can be obtained in the blue band from orbital altitudes, despite atmospheric haze. It is seen that use of this spectral region will substantially increase the information content of multispectral imagery for oceanography, particularly for water color assessment. Blue color separations from space photos are presented, together with multispectral images of floating targets and targets submerged to depths up to 25 m. Since many previous objections can be overcome with the aid of orbital remote sensing, oceanographers should reexamine the information potential of imagery for their purpose. V.P.

A70-27169 Emission, reflection, and absorption of microwaves at a smooth air-water interface. H. A. Hyatt (McDonnell Douglas Astronautics Co., Santa Monica, Calif.). *Journal of Quantitative Spectroscopy and Radiative Transfer*, vol. 10, Apr. 1970, p. 217-246. 20 refs. Research supported by the McDonnell Douglas Astronautics Independent Research and Development Program.

The purpose of this paper is to report numerical calculations for the microwave reflection, absorption, and thermal emission from a smooth air-water interface. These calculations were made by utilizing the Debye equation for the real and imaginary parts of the complex dielectric constant, as experimentally evaluated for water by Saxton and Lane. The coefficient of reflectivity was calculated from the Fresnel equations, and by assuming Kirchhoff's law the coefficient of emissivity and thermal emission was subsequently determined. (Author)

A70-27746 Spacecraft for ocean exploration. Edward Wenk, Jr. (National Council on Marine Resources and Engineering Development, Washington, D.C.). In: Manned laboratories in space; International Academy of Astronautics, International Astronautical Congress, 19th, International Orbital Laboratory Symposium, 2nd, New York, N.Y., October 18, 1968, Proceedings. Edited by S. F. Singer. Dordrecht, D. Reidel Publishing Co. (Astrophysics and Space Science Library. Volume 16), 1969, p. 68-74. 5 refs.

Study of the potential of spacecraft oceanography for ocean exploration, which evidence to date suggests is great. Synoptic scanning from orbiting platforms can perform the work of many ocean surface sensors in observing large-scale oceanic processes. Satellite scans offer unique possibilities for broad, unified synoptic analyses. Such observations are ideally suited to the International Decade of Ocean Exploration for the 1970s, a concerted, long-term, international cooperative program of ocean exploration on a world-wide basis. It is anticipated that, although oceanic data obtained from space today is less quantitative than surface observations, the coming decade will see improvements. Combined with data obtained from ships and buoys, spacecraft observations will provide a new and useful capability. F.R.L.

A70-28003 A laser profilometer. Wiley S. Olsen and Robert M. Adams (Texas, University, Austin, Tex.). *Journal of Geophysical Research*, vol. 75, Apr. 20, 1970, p. 2185-2187.

This paper is a functional description of the ARL laser profilometer, a special-purpose laser device built to measure ocean-wave profiles from an airborne platform. Mounted in an aircraft flying at 60 meters above the surface and at 240 km/hr, the profilometer yields data which are processed to produce a vertical-section trace of the ocean surface showing ripples of 2.5 cm or less and waves of any height. (Author)

A70-30345 Sun glitter viewed from space. Stanley D. Soules (ESSA, National Environmental Satellite Center, Washington, D.C.). *Deep-Sea Research and Oceanographic Abstracts*, vol. 17, 1970, p. 191-195. 13 refs.

Space photographs of sun glitter on the sea are presented to illustrate some surface oceanographic phenomena that are visible from about 200 km above the Earth when the sea is relatively calm. Wind and sea conditions seem to affect the shape and brightness of glitter patterns. In the Gulf of California, eddies in slicks may have been created by surface currents when wind speeds were very low. Off Socotra in the Indian Ocean, a series of long slick-like lines over an undersea shelf possibly are caused by internal waves. Slicks in the Formosa Strait appear as bright streaks near the horizontal specular point and as dark streaks outside this zone. Long swells and dark swaths in calm areas are also visible in the pictures. (Author)

A70-32069 # Determination of sea surface temperature and atmospheric humidity from satellite measurements of the thermal radio emission of the earth-atmosphere system (Opredelenie temperatury morskoi poverkhnosti i vlagosoderzhanii atmosfery po izmereniiam teplovogo radioizlucheniia sistemy zemlia-atmosfera s ISZ). E. P. Dombkovskaia. In: Satellite meteorology (Sputnikovaia meteorologiya).

Edited by V. G. Boldyrev and N. F. Vel'tishchev. Leningrad, Gidrometeoizdat (Gidrometeorologicheskii Nauchno-Issledovatel'skii Tsentr SSSR, Trudy, No. 50), 1969, p. 75-85. 16 refs. In Russian.

Development of a method of determining the thermal radio emission of the system composed of the earth and the atmosphere in the direction normal to the earth's surface, for both quiet days (smooth sea surface) and cloudy windy days, at wavelengths of 0.8 m 1.35, 1.6, 3.2, and 8.5 cm. Some preliminary results of statistical data processing, in particular, relationships between the radio brightness temperature at wavelengths of 8.5 and 1.35 cm and the

temperature of the underlying surface, and between this radio brightness temperature and the atmospheric humidity, are discussed. V.P.

A70-33713 The use of satellite cloud photography to infer oceanographic phenomena. James R. Greaves and Clinton J. Bowley (Allied Research Associates, Inc., Concord, Mass.). In: Technology today and tomorrow; Canaveral Council of Technical Societies, Space Congress, 7th, Cocoa Beach, Fla., April 22-24, 1970, Proceedings. Volume 1. Edited by T. H. Hanrahan. Cape Canaveral, Fla., Canaveral Council of Technical Societies, 1970, p. 6-5 to 6-15. 16 refs. Research supported by the Woods Hole Oceanographic Institution.

Several years of satellite cloud photography were examined to determine to what extent oceanographic phenomena might be revealed through their influence on the local cloud structure. The region of the Peru Current was selected for the study. As anticipated, indications of known oceanographic features including the Peru Current itself and local upwelling centers were noted. Previously unknown features such as an apparent band of warmer water off the Peruvian coast and anomalous patches of calm water in midocean were also found. A seasonal cloud climatology for the Peru Current area was developed. The importance of coordinated studies using satellites, ships and aircraft is emphasized. (Author)

A70-33725 Satellite-observed sunglint patterns - Unusual dark patches. Clinton J. Bowley (Allied Research Associates, Inc., Concord, Mass.). In: Technology today and tomorrow; Canaveral Council of Technical Societies, Space Congress, 7th, Cocoa Beach, Fla., April 22-24, 1970, Proceedings. Volume 1. Edited by T. H. Hanrahan. Cape Canaveral, Fla., Canaveral Council of Technical Societies, 1970, p. 11-29 to 11-39. 11 refs.

Anomalous dark areas in sunglint patterns are frequently observed in the Applications Technology Satellite (ATS) photography. These dark areas appear to be caused by relatively calm surface conditions against a background of higher sea states. Evidence of cold water temperatures suggests the presence of upwelling. These sightings may thus be of importance to the fishing industry. (Author)

A70-35619 The significance of spectral changes in light scattered by the sea. George L. Clarke (Harvard University, Cambridge, Mass.). In: Remote sensing in ecology; Ecological Society of America and American Society of Limnology and Oceanography, Symposium, Madison, Wis., June 19, 1968, Proceedings.

Edited by P. L. Johnson. Athens, Ga., University of Georgia Press, 1969, p. 164-172. 7 refs. NSF-supported research.

Determination of the spectral distribution of visible daylight entering the sea by means of a special high-sensitivity radiometer at two locations off New England. Both downwelling and upwelling radiation were measured above the sea surface and at a series of depths from shipboard. Upward scattered light was measured simultaneously from an aircraft. Since changes in the spectrum are affected by differences in the plankton and/or in the dissolved and particulate matter in the sea, the procedure suggests a method for the rapid delineation of water masses from the air, and possibly of areas of high productivity. F.R.L.

A70-35620 Aerial photographic studies of shallow water benthic ecology. Mahlon G. Kelly (New York University, University Heights, N.Y.) and Alfred Conrod (MIT, Cambridge, Mass.). In: Remote sensing in ecology; Ecological Society of America and American Society of Limnology and Oceanography, Symposium, Madison, Wis., June 19, 1968, Proceedings.

Edited by P. L. Johnson. Athens, Ga., University of Georgia Press, 1969, p. 173-184. 7 refs. Research supported by the American Museum of Natural History; Contract No. N-623(06)-2082.

Examination of a test site on the west edge of the Bahama Banks using aerial and satellite photographs. The location, depth, and

qualitative characteristics of the bottom biota, sediments, and morphology can be determined. The density of the bottom algae and 'grasses' as well as the dominant species can be estimated, and many of the relationships between different bottom communities and the environment can be qualitatively estimated. F.R.L.

A70-35621 Surface temperature patterns of Hudson Bay from aerial infrared surveys. Wayne M. Wendland and Reid A. Bryson (Wisconsin, University, Madison, Wis.). In: Remote sensing in ecology; Ecological Society of America and American Society of Limnology and Oceanography, Symposium, Madison, Wis., June 19, 1968, Proceedings. Edited by P. L. Johnson.

Athens, Ga., University of Georgia Press, 1969, p. 185-193. 13 refs. Navy-supported research.

Study of surface temperature patterns of Hudson Bay taken from four near-synoptic surveys during the ice-free seasons of 1965 and 1967. An airborne infrared radiation thermometer provided essentially continuous data over a known track. Certain large-scale surface thermal features persisted throughout most of the ice-free season, from soon after ice-loss until early October, when feature definition gave way to a weak south-north temperature gradient. The melt water of the last significant pack ice remained a surface thermal feature throughout the summer and into early fall. F.R.L.

A70-36969 # Attenuation of the thermal radiation of a water surface by the atmosphere according to measurements of an airborne radiation thermometer (Oslablenie teplovogo izlucheniia vodnoi poverkhnosti atmosferei po dannym izmerenii radiatsionnykh termometrom s samoleta). E. A. Martynova. In: Study of radiation processes in the atmosphere and problems of satellite meteorology (Issledovanie radiatsionnykh protsessov v atmosfere i voprosy sputnikovoi meteorologii). Edited by K. S. Shifrin

and V. L. Gaevskii. Leningrad, Gidrometeoizdat (Glavnaia Geofizicheskaya Observatoriia imeni A. I. Voeikova, Trudy, No. 235), 1970, p. 142-145. 5 refs. In Russian.

Study of the influence of the intermediate atmospheric layer on the transport of the thermal radiation rising from a water surface to an aircraft-borne radiation thermometer, based on experimental data from aircraft measurements. The methods used in determining the intensity of the rising radiation at the level of the water surface and in calculating its attenuation at the altitude of the aircraft-borne radiation thermometer are described. The results include the finding that the water-surface radiation, partly absorbed by the atmosphere, is somewhat compensated for this loss by the added radiation of the air layer between the underlying surface and the aircraft-borne radiation thermometer, as well as by the water-surface reflected back radiation of the atmosphere. M.V.E.

A70-42122 # The determination of sea-surface temperature from satellite high resolution infrared window radiation measurements. W. L. Smith, P. K. Rao, R. Koffler, and W. R. Curtis (ESSA, National Environmental Satellite Center, Washington, D.C.). *Monthly Weather Review*, vol. 98, Aug. 1970, p. 604-611. 9 refs.

Development of a statistical histogram method, using which sea-surface temperatures can be objectively determined from satellite high-resolution window radiation measurements. The method involves inferring the distribution of surface radiances for the clear atmospheric case from observed histograms of generally cloud-contaminated radiances. The brightness temperature associated with the clear-atmosphere modal peak radiance is the statistically most probable surface temperature. The reliability of the inferred surface temperature depends on the number of cloud-free measurements available to define the clear mode. The method accounts for atmospheric attenuation and instrumental noise, and discriminates objectively cloud-free from cloud-contaminated observations. V.P.

A70-42766 Ocean swell measurements from satellite

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photographs. Vincent E. Noble (U.S. Navy, Naval Oceanographic Office, Washington, D.C.). *Remote Sensing of Environment*, vol. 1, Summer 1970, p. 151-154.

Discussion of Fourier optical analyzer techniques used to measure sea swell wavelength and propagation direction from Apollo 7 space photography. Ocean swell wavelengths of 366 m (originating from Typhoon Gloria, located at 23 deg N, 132 deg E) were measured in the region of Biak Island near New Guinea. These results document the usefulness of optical Fourier transform methods for determination of ocean swell wavelengths. The technique is extremely rapid for scanning numbers of photographs. However, its accuracy depends directly on the accuracy of the specification of the photographic parameters and on the linear characteristics of the swell wave form. M.V.E.

A70-42770 Utilizing satellite-observed solar reflections from the sea surface as an indicator of surface wind speeds. Alan E. Strong and Irwin S. Ruff (ESSA, National Environmental Satellite Center, Washington, D.C.). *Remote Sensing of Environment*, vol. 1, Summer 1970, p. 181-185. 7 refs.

Discussion of the possibility to determine ocean roughness conditions from the sunglint patterns on satellite photographs. It is demonstrated with ESSA satellite photographs that sunglint patterns can be separated into several categories as a function of ocean roughness conditions. The small, but intensely brilliant, sunglint characterizes a calm sea (swell may be ignored). Highly variable brightness patterns result from reflections off a slightly roughened ocean surface with irregularly interspersed patches of swaths of smooth water. These frequently observed patterns typify those lower wind speeds (ca. 5 m per sec) where atmospheric stability becomes a critical factor in wave development. A third category comprises yet rougher seas that diffuse the solar image to such an extent (i.e., the reflection pattern is characterized by low intensity and great expanse) that the sunglint is barely discernible. Data suggest this threshold occurs at winds near 10 m per sec for the present generation of ESSA satellites. Using wave-slope statistics, which are governed by wind stress, a model is offered for mapping satellite-observed sunglint patterns onto an earth-coordinate system. M.V.E.

A70-43668 * Simulated terrain mapping with the rotating gravity gradiometer. Curtis C. Bell, Robert L. Forward (Hughes Research Laboratories, Malibu, Calif.), and Harvell P. Williams (NASA, Huntsville, Ala.). In: *Advances in dynamic gravimetry; Proceedings of the Symposium on Dynamic Gravimetry*, Fort Worth, Tex., March 16, 17, 1970. Edited by W. T. Kattner. Pittsburgh, Instrument Society of America, 1970, p. 115-128; Discussion, p. 129. 45 refs. Contract No. NAS 8-24788.

We present the results of an experimental simulation of the gravity gradient profile that we expect to obtain from a rotating gravity gradiometer passing over terrain with subsurface density fluctuations. The simulation was carried out by constructing a scaled down simplified model of the terrain with density variations similar to those expected in the real terrain. The model was moved past our laboratory version of the rotating gravity gradiometer and the output of the sensor was plotted as a function of the relative position of the sensor with respect to the simulated mass distribution. The resultant gravity gradient profile is compared with that predicted by our computer program for the same configuration. The situation simulated in the experiment was that of a lunar spacecraft at 30 km altitude orbiting over various mascon structures. Because of the 1/R super 3 characteristic of the gravity gradient, however, the simulation could apply equally to an aircraft at 3 km altitude flying over large geological structures many kilometers down, or an aircraft at 300 m altitude looking at small local structures near the surface. (Author)

A70-43802 * Bistatic-radar observation of long-period, directional ocean-wave spectra with Ioran A. Allen M. Peterson, Calvin C. Teague, and G. Leonard Tyler (Stanford University, Stanford, Calif.). *Science*, vol. 170, Oct. 9, 1970, p. 158-161. 9 refs. Grant No. NGL-05-020-014.

A70-45361 Oceanographic interpretation of Apollo photographs. Robert L. Mairs (U.S. Naval Oceanographic Office, Washington, D.C.). *Photogrammetric Engineering*, vol. 36, Oct. 1970, p. 1045-1058. 14 refs.

Study of the origin, movement, and dissipation of masses of discolored water on North Carolina's shelf, based on the evaluation of Apollo IX photographs, color band separations, and oceanographic and meteorological data. A model was developed incorporating jet theory, climatology, currents, surface temperatures, color separations, and other oceanographic data to explain the processes involved in the life cycle of these discolored water masses seen in Apollo photograph AS9-3128. It is shown that variability patterns, shown by color space photographs, in conjunction with pertinent historical and environmental data, plus a concurrent ground truth collection program, can provide valuable synoptic, oceanographic data. Space photography is demonstrated to be a powerful tool for the development of a detailed understanding of the basic patterns of circulation, flushing, and mixing on the continental shelves of the world. O.H.

A70-46400 * # Remote sensing of ocean currents and sea surface temperature changes derived from the Nimbus II satellite. Guenter Warnecke, Lewis J. Allison, Karl-Heinz Szekielda (NASA, Goddard Space Flight Center, Meteorology Branch, Greenbelt, Md.), and Larry M. McMillin (NASA, Goddard Space Flight Center, Greenbelt, Md.; Allied Research Associates, Inc., Concord, Mass.). *Journal of Physical Oceanography*, vol. 1, Jan. 1971, p. 45-60. 37 refs.

Analysis of Nimbus 2 HRIR (High-Resolution Infrared Radiometer) data, sensitive in the 3.4 to 4.2 micron window, for several oceanic regions. Current boundaries, such as the north wall of the Gulf Stream, could be located consistently within 10 km of the positions indicated by airplane radiation data. With present techniques, primarily designed for meteorological purposes, it proved possible to observe the Gulf Stream boundary on about 50 out of 175 days. Similar results were also obtained in analysis of the Agulhas Current boundary and the boundary between the Brazil and Falkland Currents. The satellite radiation observations suggest that the Brazil-Falkland Current boundary, which is associated with a surface temperature gradient, is as sharp and strong as the north wall of the Gulf Stream. The Agulhas Current exhibits a similar temperature gradient along its western boundary which separates it from Benguela Current surface waters. Comparison between equivalent blackbody temperatures over the Gulf Stream from Nimbus 2 and low flying radiometer-equipped aircraft showed that the satellite data were on the average warmer by 0.5 C. Seasonal sea surface temperature variations of 9 C over the Persian Gulf and Somali region and the upwelling along the Somali coast during the southwest monsoon were clearly detected in the nighttime HRIR data. Daytime observations within the 3.4 to 4.2 micron window also revealed qualitatively the location of major current boundaries. V.P.

A (1.85 megahertz) transmissions and a receiver located 280 kilometers away. The received echoes have been converted into a time-delay, Doppler-frequency map in which the effects of anisotropies in the ocean-wave spectra are clearly shown. The distribution of the echoes in delay-Doppler space is consistent with Bragg scattering from trains of dispersed ocean waves. (Author)

A71-10600 # Spectrum analysis of radar sea return. George F. Andrews (Miami, University, Miami, Fla.). In: *American Meteorological Society, Radar Meteorology Conference, 14th, Tucson, Ariz., November 17-20, 1970, Proceedings*. Boston, American Meteorological Society, 1970, p. 449-451. 10 refs. Contract No. N 00019-68-C-0393.

Description of a method for obtaining remote sea-state information using a video attachment to an existing radar system. The recording and analysis system developed to store and analyze both radar and wave sensor data is briefly discussed. The Radar Sea State Analyzer, an instrument which has evolved from these studies, can increase the potential utility of an existing coastal radar by providing information about the ocean. M.M.

A71-14638 # Influence of the state of the sea surface on the accuracy of determining atmospheric humidity and the water content of clouds by radio measurements from artificial earth satellites (O vliianii sostoiianiia morskoi poverkhnosti na tochnost' opredeleniia vlagosoderzhanii atmosfery i vodozapasa oblakov pri radiometricheskikh izmereniiakh s iskusstvennykh sputnikov zemli). L. M. Mitnik and A. M. Shutko (Akademiia Nauk SSSR, Institut Radiotekhniki i Elektroniki, Moscow, USSR). *Meteorologiya i Gidrologiya*, Oct. 1970, p. 72-75. 6 refs. In Russian.

Estimate of the errors which will arise in atmospheric humidity and cloud moisture determinations over a turbulent sea surface when the calculations are based on radio brightness values for a smooth quiescent surface. Attention is given to cases of horizontal and vertical polarization at angles between 0 and 45 deg to the vertical. Formulas are given for the errors as a function of the ambiguity in the spectral radiant emittance of a turbulent sea surface. T.M.

A71-16274 # Sea morphology from satellite photographs (Meeresmorphologie aus Satelliten-luftbildern /SLB/). H. Kaminski (Bochum, Sternwarte, Bochum, West Germany). *International Astronautical Federation, International Astronautical Congress, 21st, Konstanz, West Germany, Oct. 4-10, 1970, Paper. 56 p. 22 refs.* In German.

Discussion of the potential value of satellite photographs of the sea, particularly in the photograph portions corresponding to the sun reflex zone, as sources of information on sea morphology. The sun reflex zone represents that region on each photograph in which the satellite camera 'sees' the mirrored reflection of the sun. Within that zone, which for a camera altitude of 1050 to 1150 km (e.g., on Nimbus satellites) measures on sea photographs nearly 950 km across, underwater structures such as submarine hilltops, trenches, cliff walls, and canyons can be identified up to depths of 4 km and more. The application of the equidensity color process based on Agfa contour films is shown to enhance the resolution sharpness of minute detail and to expand interpretation possibilities. Some problem areas are discussed, and certain directions for future research are suggested. M.V.E.

A71-17045 Solar reflection from the sea surface - Possibility of determining the position of high-pressure ridges from satellite photographs (Sonnenreflexion an der Meeresoberfläche - Möglichkeit, die Lage von Hochdruckachsen aus Satellitenbildern zu entnehmen). Tillmann Mohr. *Meteorologische Rundschau*, vol. 23, Nov.-Dec. 1970, p. 177-180. 6 refs. In German.

Discussion of the irregularities in sea-surface sunglint patterns noticed in photographs taken from earth-orbiting satellites. Of particular interest are patches or swaths of ocean surface that appear dark, within brighter sunglint regions. Calculations from models indicate that these patches correspond to calm water zones beneath high-pressure ridges. M.V.E.

A71-17101 # Remote sensing of sea conditions with microwave radiometer systems. J. C. Aukland, P. J. Caruso, Jr., and W. H. Conway (Spectran, Inc., Buena Park, Calif.). (*American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-318.*) *Journal of Hydronautics*, vol. 5, Jan. 1971, p. 15-19. 5 refs.

Consideration of microwave radiometric techniques, recently developed to provide continuous all-weather monitoring of sea conditions from satellites. Ground-based measurements indicate that foam and surface ripple must be considered in any system measuring sea state or sea temperature. The presence of foam significantly modifies the radiometric temperature, depending on the quantity of foam in the beam. The measurements further point out the need for airborne measurements to generate curves for sea state determination. F.R.L.

A71-17560 * Estimation of sea surface temperature from space. D. Anding and R. Kauth (Michigan, University, Ann Arbor, Mich.). *Remote Sensing of Environment*, vol. 1, Dec. 1970, p. 217-220. Contract No. NAS 12-2117.

A procedure is derived for obtaining improved estimates of

water surface temperature by means of spatially scanning space-borne systems which would perform simultaneous radiometric measurements in two wavelength intervals in the thermal infrared atmospheric-window spectral regions. The procedure should reduce errors in the estimate of water surface temperature caused by haze and water vapor effects from approximately plus or minus 2 C to approximately plus or minus 0.15 C. (Author)

A71-18824 Utilization of a radar altimeter for determination of ocean roughness. Isadore Katz (Johns Hopkins University, Silver Spring, Md.). In: *EASCON '70; Institute of Electrical and Electronics Engineers, Electronics and Aerospace Systems Convention, Washington, D.C., October 26-28, 1970, Record.*

New York, Institute of Electrical and Electronics Engineers, Inc., 1970, p. 266-269. 5 refs.

Experimental radar backscatter data are available from which one can assess the feasibility of determining sea conditions from radar data alone. At angles other than near vertical incidence, higher wind speed results in larger normalized radar cross-sections. The exact relationship between wind speed, ocean roughness and radar backscatter is yet to be obtained, but there is sufficient evidence now available to suggest that the entire clutter-versus-incidence-angle curve will provide useful oceanographic information. We also examine the utility of backscatter data taken solely around vertical incidence. A method is proposed for using a satellite altimeter to obtain wave height information. The method makes use of the relationship between the doppler broadening of the received radar signal and wave height. The signal reflected from the sea surface is fed into a band of filters whose outputs determine the roughness; the higher frequency of the doppler broadened signal the larger are the waves. (Author)

A71-22301 # Special features of the moisture field over the oceans according to the results of radiometric microwave measurements with the Cosmos 243 satellite (Osobennosti polia vlazhnosti nad okeanami po dannym radiometricheskikh sverkhvysokochastotnykh izmerenii s ISZ 'Kosmos-243'). A. E. Basharinov and L. M. Mitnik (Akademiia Nauk SSSR, Institut Radiotekhniki i Elektroniki, Moscow, USSR). *Meteorologiya i Gidrologiya*, Dec. 1970, p. 13-18. In Russian.

Evaluation of data obtained from a statistical treatment of the results of radiometric microwave sounding of the atmospheric moisture field in the 1.35-cm band during an experiment on board the Cosmos 243 satellite. Certain peculiarities are noted in the latitudinal dependences of the total moisture content upon averaging along latitudinal belts (a displacement of the 'dome' to the Northern Hemisphere, characteristic latitudinal gradients). The total mass of water vapor in the earth's atmosphere is estimated at 1.25×10^{20} to the 19th grams. A.B.K.

A71-23448 Use of side-looking air-borne radar for sea ice identification. Jimmie D. Johnson and L. Dennis Farmer (U.S. Coast Guard, Office of Research and Development, Washington, D.C.). *Journal of Geophysical Research*, vol. 76, Mar. 20, 1971, p. 2138-2155.

An experiment was conducted to assess the performance of side-looking airborne radar (SLAR) in mapping and identifying sea ice parameters. A Philco-Ford AN/DPD-2 (Modified) SLAR was installed on a Coast Guard C-130 aircraft and flown on an experimental basis during September 1969 in conjunction with the S.S. Manhattan's transit of the Northwest Passage. In addition to the research effort to determine its feasibility as an ice observational technique, the SLAR was also used as a routing aid to the Manhattan. The results of this experiment indicate that SLAR can readily be used to detect ice concentrations, floe size and number, and water openings, and to identify, through careful image interpretation, ice age, ice drift, surface topography, fractures, and pressure characteristics. SLAR's broad areal coverage, all weather, day and night capability make it an effective means of observing sea ice, and for many purposes it provides observations superior to information obtained by a visual ice observer. G.R.

A71-23590 Sea-surface temperature measurements by infrared radiometer. M. Colacino, F. M. Vivona (CNR, Istituto di Fisica dell'Atmosfera, Rome, Italy), and E. Rossi (Istituto Idrografico della Marina, Genoa, Italy). *Pure and Applied Geophysics*, vol. 83, no. 6, 1970, p. 98-110. 8 refs.

After a brief description of Barnes PRT-5 radiometer and of its possible use for sea-surface temperature measurements, the results obtained during an oceanographic survey in April 1969 in the Tyrrhenian Sea are presented. The data of the radiometer are compared with those obtained from bucket measurements, applying a statistical method. Satisfactory agreement between the two series of values is found. The influence of the inclination angle of a radiometer on the sea surface temperature measurements is also examined. The results agree with the data previously obtained by other authors. (Author)

A71-26504 # Aerial and orbital remote sensing of water quality. P. B. Chandler (North American Rockwell Corp., Space Div., Downey, Calif.). In: Institute of Environmental Sciences, Annual Technical Meeting and Equipment Exposition, 17th, Los Angeles, Calif., April 26-30, 1971, Proceedings. Mt. Prospect, Ill., Institute of Environmental Sciences, 1971, p. 219-228. 5 refs.

Criteria which have to be met in connection with a monitoring system for waste materials and their effects on the basic coastal marine environment are examined. The employment of remote sensors for obtaining the needed information is discussed taking into consideration factors of sensor selection and its relation to observable characteristics. The relative merits of spacecraft and aerial sensing are compared. Future developments such as Skylab's multi-spectral facilities are considered. It is hoped that with new developments spectral and aerial resolutions will become available for doing gross water quality monitoring from orbit. Aspects regarding the determination of heated discharge in water are investigated, and approaches for the detection of oil pollution and of algae are discussed. The determination of turbidity and color, vessel waste discharge, storm drain discharge, and of shoreline facility discharge is considered. G.R.

A71-27098 # Latitudinal distribution of the integral water content of clouds above the earth's sphere from Cosmos-243 measurement data (Shirotnoe raspredelenie integral'noi vodnosti oblakov nad zemnym sharom po dannym izmerenii s ISZ 'Kosmos-243'). A. B. Akvilonova, B. G. Kutuz, and L. M. Mitnik (Akademiia Nauk SSSR, Institut Radiotekhniki i Elektroniki, Moscow, USSR). *Akademiia Nauk SSSR, Izvestiia, Fizika Atmosfery i Okeana*, vol. 7, Feb. 1971, p. 139-144. 9 refs. In Russian.

The integral water content of clouds, defined as the total water content in droplet form per unit area πR^2 , the line of sight of the antenna in the direction of the nadir, is analyzed with particular reference to its latitudinal distribution above the Pacific, Atlantic, and Indian Oceans. It is found that the water content in the intertropical convergence zone is very high and very low in the equatorial and tradewind zones. The total mass of atmospheric water (in droplet form) during the period from Sept. 23 to 27, 1968, is found to equal 8.7 times 10 to the 16th power g. V.P.

A71-27260 Airborne remote sensing techniques for oceanographic data acquisition. Carl O. Thomas (Environmental Systems Corp.). In: International Society of Photogrammetry, American Society of Photogrammetry, and Ohio State University, International Symposium on Photography and Navigation, Columbus, Ohio, May 25-28, 1970, Proceedings. Edited by S. K. Ghosh. Columbus, Ohio State University, 1971, p. 159-170. 8 refs.

A general review is provided of those airborne remote sensing techniques which make use of the EM spectrum from the very near UV, through the visible, the near IR, the thermal IR, and into the microwave region. Instruments now available for these regions utilize reflected radiation (for example, cameras and radar) and emitted radiation (for example, thermal mappers or passive microwave

radiometers). Such instruments record data primarily of the surface characteristics of the ocean, other water bodies or terrain. In certain regions of the spectrum, there may be moderate penetration of water. In other regions, there are atmospheric effects. G.R.

A71-27983 * # Ocean-height measurement by satellite altimetry. J. G. Marsh (NASA, Goddard Space Flight Center, Greenbelt, Md.) and B. C. Douglas (Wolf Research and Development Corp., Riverdale, Md.). *Journal of Spacecraft and Rockets*, vol. 8, May 1971, p. 543-548. 6 refs.

Consideration of the accuracy of ocean-height measurement attainable by dynamic long-arc orbit determination techniques. An attempt was made to estimate the effect of model errors on the determination of satellite radial distance to see if orbit determination requirements can be met and the altimeter accurately evaluated. The results were obtained by least-squares solutions including the effect of model and instrument error in addition to random noise. Results show that if careful attention is given to scheduling of observations, orbits of the required accuracy can be obtained. F.R.L.

A71-33068 Monsoonal response in the western Indian Ocean. Walter Düing (Miami, University, Miami, Fla.) and Karl-Heinz Szekieda. *Journal of Geophysical Research*, vol. 76, June 20, 1971, p. 4181-4187. 15 refs. Contract No. N 0014-67-A-0201-0013.

IR observations from spacecraft were used for investigating the response of the Somali Current to the onset of the southwest monsoon. The time-dependent development of horizontal temperature gradients at the sea surface served as an indicator for the formation of the baroclinic structure of the Somali Current. It was found that the temperature gradients during the early formation stage in all years are directly proportional to the wind speed. The phase lag between the development of wind and temperature gradients during the buildup of the boundary current has a mean value of twelve days. During the decay period in late summer and fall, the lag increases continuously up to forty days. It is suggested that the two phenomena of different spatial scales play an important role during the formation of the Somali Current. In the early stage (May, June), local wind-induced upwelling seems to be the more important source of baroclinity. In the later stage of the buildup (July), large-scale geotropic effects seem to be dominating. Z.W.

A71-34708 # A geodetic and oceanographic satellite altimeter system. E. F. Hudson (Raytheon Co., Wayland, Mass.). *American Institute of Aeronautics and Astronautics, Space Systems Meeting, Denver, Colo., July 19, 20, 1971, Paper 71-845*. 13 p. 35 refs. Members, \$1.50; nonmembers, \$2.00.

A system to map the shape of the ocean by means of satellite altimetry is presented. The system uses the orbit of the satellite as a reference, and at points along the orbit, measurements are made of the vertical distance between the orbit and the ocean. The major elements of the system, which include the satellite and the altimeter, the systems that will track it, a command and data acquisition system, an operations control center, and a data processing system, are discussed. Two space experiments relating to the development of an operational system are described. Finally, a discussion is presented of the uses and benefits of the system and a possible schedule for its implementation. O.H.

A71-35215 * # Determination of the sea surface slope distribution and wind velocity using sun glitter viewed from a synchronous satellite. Nadav Levanon (Tel Aviv University, Tel Aviv, Israel). *Journal of Physical Oceanography*, vol. 1, July 1971, p. 214-220. 5 refs. Contract No. NASw-65.

This work demonstrates the feasibility of determining the east-west component of the sea surface slope distribution from a synchronous satellite, through quantitative analysis of the sun glitter. The Cox-Munk sun glitter technique, utilizing a single photograph of the whole-sun glitter pattern, taken from an aircraft altitude, is adapted to a much higher altitude. This is done by making a sequence of light intensity measurements, reflected from a single point on the ocean, as this fixed point scans the westward moving

sun glitter pattern. Wind velocity is calculated from the slope variance, using the Cox-Munk empirical relation. Calculated wind velocities for three locations in the Pacific, on two separate days, are compared to direct wind measurements taken at these locations during the Line Islands Experiment. The agreement is within plus or minus 1 m/sec. (Author)

A71-35216 # Gulf Stream meanders and eddies as seen in satellite infrared imagery. P. Krishna Rao, A. E. Strong, and R. Koffler (NOAR, Washington, D.C.). *Journal of Physical Oceanography*, vol. 1, July 1971, p. 237-239. 6 refs.

Description of two informative examples of surface temperature distributions over the western Atlantic which were detected by means of data from the scanning radiometer on the Improved TIROS Operational Satellite-1 (ITOS-1). The first example is a DRIR (Direct Readout Infrared) image obtained about 0900 GMT on Feb. 15, 1971 from ITOS-1. The second example is an ITOS-1 DRIR image for Mar. 5, 1971. This latter image shows breakoff eddies along the Gulf Stream boundary which occur in a region of strong shearing action between the relatively slow moving slope water and the fast moving main Gulf Stream. It is possible that they are related in some way to the bottom topography or the coastline configuration. M.M.

A71-36064 Blue multispectral region in aerospace imaging. D. S. Ross (International Imaging Systems, Mountain View, Calif.). In: Photo-optical instrumentation for the 70's; Society of Photo-optical Instrumentation Engineers, Annual Technical Symposium, 15th, Anaheim, Calif., September 14-17, 1970, Proceedings.

Symposium co-sponsored by the U.S. Air Force and the U.S. Army. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers (SPIE Annual Technical Symposium Proceedings. Volume 3), 1971, p. 149-155. 14 refs.

It is demonstrated that useful imagery can be acquired from orbital altitudes in the blue spectral region for obtaining oceanographic data. It is shown that the optimum filter passband for subsurface oceanographic recordings is roughly 460 to 500 nm in the blue and 500 to 580 nm in the green. The most complete record of subsurface ocean information appears to be obtainable with a filter passband of 460 to 580 nm when a single spectral band is feasible in synoptic remote sensing, while water color information can be secured only with separate blue and green images. The topics discussed include the characteristics of light in the water, scattered light in the water, image contrast and water color, and atmospheric haze. V.Z.

A71-36486 An in situ measurement system for GARP using balloons, buoys, and a satellite. John E. Masterson (National Center for Atmospheric Research, Boulder, Colo.). In: Technology today and tomorrow; Canaveral Council of Technical Societies, Space Congress, 8th, Cocoa Beach, Fla., April 19-23, 1971, Proceedings. Volume 2. Edited by N. A. Stein. Cape Canaveral, Canaveral Council of Technical Societies, 1971, p. 3-1 to 3-6. 18 refs.

Discussion of the makeup and scientific objectives of an in situ data acquisition system that is to serve as an observational tool for the Global Atmospheric Research Program. A low-cost random access Doppler system (RADEM) is to use orbiting satellites to recover meteorological and oceanographic data from in situ platforms in the atmosphere and on the sea, in the form of freely floating balloons and buoys. The RADEM system will be used in a scientific study in the tropics and Southern Hemisphere in 1974 and will involve the Nimbus satellite and some 300 constant-level balloons. The scientific objectives of this program include: the investigation of tropical winds in the upper troposphere; the production of a pressure reference level at 150 mb in the middle latitudes of the Southern Hemisphere; and a study of energy conversion in the atmosphere. M.V.E.

A71-38405 Feature selection for pattern classification of oceanographic remote sensing data. James H. Herzog and Carlton E. Cross (Oregon State University, Corvallis, Ore.). In: Engineering for the conservation of mankind; Institute of Electrical and Electronics

Engineers, Region Six Conference, Sacramento, Calif., May 11-13, 1971, Conference Record. Edited by M. G.

A71-39672 # Some results of microwave sounding of the atmosphere and ocean from the satellite Cosmos 243. A. E. Basharinov, S. T. Egorov, A. S. Gurvich, and A. M. Obukhov (Akademiia Nauk SSSR, Moscow, USSR). In: Space research XI; COSPAR, Plenary Meeting, 13th, and Symposium on Remote Sounding of the Atmosphere, Leningrad, USSR, May 20-29, 1970, Proceedings. Volume 1.

Meeting and Symposium co-sponsored by the International Union of Geodesy and Geophysics and the World Meteorological Organization. Edited by K. Ia. Kondrat'ev, M. J. Rycroft, and C. Sagan. Berlin, East Germany, Akademie-Verlag, 1971, p. 593-600. 7 refs.

Review of the measurements of earth and atmosphere thermal emissions performed by the Cosmos 243 satellite by means of radiometers for wavelengths of 8.5, 3.4, 1.35, and 0.8 cm. Measurements at wavelengths of 8.5 and 3.4 cm were used to determine the characteristics of ocean and earth surface emissions. These measurements were also used to determine the boundaries of the sea ice and to distinguish precipitation and intensive cloudiness above the oceans. The measurements at wavelengths 3.4, 1.35, and 0.8 cm were used to determine the integral water vapor content above the oceans. The rms deviation of the satellite measurements of the integral water vapor content from those of the radiosonde measurements is 0.2 g per sq cm. The distribution of the integral liquid water content of clouds above the oceans is plotted. The fields of integral water vapor content above the oceans are mapped. M.V.E. Jerome and Joyce Guthrey. Sacramento, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 4A-1.1 to 4A-1.6. U.S. Bureau of Commercial Fisheries Contract No. 14-17-0002-333; Contract No. N 622306-70-C-0414.

Data from a multi-spectral airborne scanner has been collected from the Pacific Ocean near the Oregon coast. This research investigates the ability of digital processing systems to locate regions of thermal upwelling and the associated high concentration of marine life. The spectral radiance in nine bands of the visible and near infrared spectrum constitute the raw data. This data is originally in analog form. The Oregon State University Hybrid computer is used to filter the data, digitize it and calibrate it. Human interaction is used to edit for cloud cover and direct solar reflection off the ocean surface. The edited data preserves the essential radiation information concerning color variations on the sea surface. Since abrupt changes in water color are thought to hold information relevant to changes in the chlorophyll composition of the water, programs were developed to search out such areas. The results indicate that some changes in sea conditions may be detected by remote sensing from aircraft and computerized data processing. This suggests that spatial interest should be devoted to utilizing space platforms such as ERTS (Earth Resources Technology Satellite) for future research in this area.

(Author)

A71-41653 # Latitudinal distribution of the integral water content of clouds over the earth according to measurement data from the Cosmos-243 satellite. A. B. Akvilonova, B. G. Kutuza, and L. M. Mitnik (Akademiia Nauk SSSR, Institut Radiotekhniki i Elektroniki, Moscow, USSR). (*Akademiia Nauk SSSR, Izvestiia, Fizika Atmosfery i Okeana*, vol. 7, Feb. 1971, p. 139-144.) *Academy of Sciences, USSR, Izvestiya, Atmospheric and Oceanic Physics*, vol. 7, Feb. 1971, p. 97-99. 9 refs. Translation.

The integral water content of clouds, defined as the total water content in droplet form per unit area along the line of sight of the antenna in the direction of the nadir, is analyzed with particular reference to its latitudinal distribution above the Pacific, Atlantic, and Indian Oceans. It is found that the water content in the intertropical convergence zone is very high and very low in the equatorial and tradewind zones. The total mass of atmospheric water (in droplet form) during the period from Sept. 23 to 27, 1968, is found to equal 8.7 times 10 to the 16th power g. V.P.

A71-41986 * # Remote sensing of chlorophyll and tempera-

ture in marine and fresh waters. John C. Arvesen, John P. Millard (NASA, Ames Research Center, Moffett Field, Calif.), and Ellen C. Weaver (San Jose State College, San Jose, Calif.). *International Astronautical Federation, International Astronautical Congress, 22nd, Brussels, Belgium, Sept. 20-25, 1971, Paper. 43 p. 20 refs.*

A spectroradiometer, a differential radiometer (capable of detecting small changes in spectral radiance between two or more wavelength regions), and an infrared filter radiometer were used to obtain airborne measurements of surface chlorophyll in specific water bodies that included fresh water lakes at high and low eutrophic levels, marine waters of high and low productivity, and an estuary with high sediment content. Results of specific flights are presented to show the continuous, real-time synoptic nature of the information obtained by remote sensing and to illustrate the significance of remote sensing for marine biological investigations. Several of the examples are concerned only with chlorophyll determination, while others involve simultaneous chlorophyll and temperature measurements. The differential radiometer appears to be capable of providing a continuous indication of surface chlorophyll concentration along the flight path from less than 0.03 mg/cu m to greater than 10 mg/cu m. T.M.

A71-42545 * Correlation of radar backscattering cross sections with ocean wave height and wind velocity. K. Krishen (Lockheed Electronics Co., Houston, Tex.). (*International Scientific Radio Union, Spring Meeting, Washington, D.C., Apr. 16-19, 1970.*) *Journal of Geophysical Research*, vol. 76, Sept. 20, 1971, p. 6528-6539. 26 refs. Contract No. NAS 9-5191.

The relationship between scattering cross section, wind velocity, and fully developed seas was determined from NASA scatterometer data (13.3 GHz and 0.4 GHz) acquired over ocean scenes. Interpretation of the data was based upon the composite scattering theory. The initial results of the study indicate several predictable parameters that can be used for evaluating sea-surface conditions. (Author)

A71-42547 Some mechanisms of oceanic mixing revealed in aerial photographs. G. Assaf, R. Gerard, and A. L. Gordon (Lamont-Doherty Geological Observatory, Palisades, N.Y.). *Journal of Geophysical Research*, vol. 76, Sept. 20, 1971, p. 6550-6572. 19 refs. AEC Contract No. AT (31-1)-2663; Contract No. N 62306-67-C-0296.

Estimates of circulation rates within the mixed layer of the ocean have been made based on aerial photographs of a variety of dye injections and floating cards in the surface and near-surface levels under different wind, sea state, and thermal profile conditions. The main features derived from studies of the circulation patterns in the mixing layer in the Bermuda area are: (1) except under calm conditions, the first few meters of the sea are subjected to helical flow of small-size Langmuir cells with 3 to 6 m spacing between the convergence lines; (2) under moderate to strong wind conditions a hierarchy of larger-size Langmuir cells is developed; (3) a stratified flow resembling an Ekman spiral is observed under moderate conditions; (4) there is coexistence between the small-size Langmuir cells and the Ekman spiral below; and (5) under calm conditions following a period of moderate winds and thermal instability, convergence zones having anticyclonic rotation with inertial period were observed. M.M.

A71-42549 * Precision requirements for a spacecraft tide program. Bernard D. Zetler and George A. Maul (NOAA, Physical Oceanography Laboratory, Miami, Fla.). *Journal of Geophysical Research*, vol. 76, Sept. 20, 1971, p. 6601-6605. 10 refs. NASA-supported research.

Evaluation of errors and signal degradation in tidal analyses of sea-surface elevations from an orbiting altimeter in a numerical feasibility investigation with the use of observed hourly heights at two tide stations and a hypothetical satellite orbit with a 30 deg inclination and a period of about 95 min. For a station at 13 deg N with a water elevation assumed to be obtained each time the

altimeter transits a 1 deg square centered at the station, 86 observations are obtained in 1 yr. For a station at 22 deg N, areas of 1 to 5 deg square were used and the number of observations in 1 yr varied from 112 to 551. Signal degradation is studied by introducing sequentially increased levels of white noise to the observations. The results indicate that previously stated minimum precision requirements for a spacecraft tide program can be relaxed by roughly an order of magnitude. M.M.

A71-42885 Gulf Stream and Middle Atlantic Bight - Complex thermal structure as seen from an environmental satellite. P. K. Rao, A. E. Strong, and R. Koffler (NOAA, National Environmental Satellite Service, Hillcrest Heights, Md.). *Science*, vol. 173, Aug. 6, 1971, p. 529, 530. 5 refs.

High-resolution infrared imagery from theITOS 1 satellite demonstrates the utility of synoptic sea-surface temperature information. The northern edge of the Gulf Stream, the slope waters, and the shelf waters display complex thermal characteristics with distinct temperature gradients separating these three water masses. This type of information can be very useful for increasing our understanding of many physical phenomena that occur over Earth's oceans. (Author)

A71-44050 # Relationship between outgoing microwave emission and the state of the sea surface (on the basis of Cosmos 243 data). (O svyazi ukhodiashego mikrovolnovogo izlucheniia s sostoianiem poverkhnosti moria /po dannym sputnika 'Kosmos-243'/). L. M. Martsinkovich (Glavnoe Upravlenie Gidrometeorologicheskoi Sluzhby SSSR, Gidrometeorologicheskii Nauchno-Issledovatel'skii Tsentr, Leningrad, USSR) and D. T. Matveev (Akademiia Nauk SSSR, Institut Fiziki Atmosfery, Moscow, USSR). *Veterologiya i Gidrologiya*, Aug. 1971, p. 50-59. 16 refs. In Russian.

Radiometric satellite data are analyzed in combination with wind-wave data. It is shown that there exists a distinct relationship between the radio brightness temperature and the state of the sea surface. This relationship is seen to be useful for determining storm regions in the ocean from radiometric data. V.P.

A71-44986 Airborne laser profiling of the Arctic pack ice. Robert D. Ketchum, Jr. (U.S. Naval Oceanographic Office, Ocean Science Dept., Washington, D.C.). *Remote Sensing of Environment*, vol. 2, Oct. 1971, p. 41-52.

Description of the results of an analysis of laser terrain profile data obtained with coincident photography from an altitude of 1000 ft over the sea ice fields of the Beaufort Sea in April 1968. Analysis of the data reveals that sea ice surface roughness and the nature of the roughness as well as relative surface reflectivities, which are both manifested in the laser terrain profile, can be used to interpret the categorical stages of ice development. The laser terrain profiler seemingly detected, with acceptable accuracy, all ice features traversed; however, ice pressure ridges, ice hummocks, or ice blocks could not be distinguished from each other on the record because the measurement is only two-dimensional. These features were always detectable even when occurring in rapid succession. Cracks are very discernible on the laser terrain profile record. M.M.

A71-45082 Measurement of ocean wave heights with the random-signal radar. Russell B. Chadwick (NOAA, Institute of Telecommunication Sciences, Boulder, Colo.) and George R. Cooper (Purdue University, Lafayette, Ind.). *IEEE Transactions on Geoscience Electronics*, vol. GE-9, Oct. 1971, p. 216-221. 7 refs. Grant No. DA-AB-07-67-C-0409; Contract No. N 00163-68-C-0106.

When a radar antenna is pointed directly down at the sea surface, the return signal is caused mainly by specular points on the surface. In this case, the sea surface can be modeled as a collection of Poisson-distributed point scatterers, each having a certain radar range and a certain vertical velocity. This model can be characterized by a deterministic function, called the scatterer density function, which is the density of specular point scatterers in the two-dimensional

range-velocity space. This function can be estimated by using a high-resolution random-signal radar and provides information relating the dynamic aspects of the ocean surface to the distribution of wave heights. A special case of this problem is the estimation of average wave height, or sea state, and a specific technique to estimate this quantity is proposed and analyzed. M.M.

A71-45083 * Averaged pulse-shape measurements of radar sea return at near-vertical incidence. Nadav Levanon (Tel Aviv University, Tel Aviv, Israel). *IEEE Transactions on Geoscience Electronics*, vol. GE-9, Oct. 1971, p. 233-241. 11 refs. Contract No. NAS 5-11542.

Some average pulse-shape measurements of radar sea returns at near-vertical incidence are presented. The measurements were made at a 75-cm wavelength, from light aircraft flying at altitudes of 2 to 2.3 km over various water surfaces. Greater knowledge of the return shapes could help the design of high-accuracy radar altimeters. It could also contribute to several areas of remote sensing. Both specular and scattered reflections were observed in all the returns, with clear distinction between the two components. Dominance by either the specular or the scattered component was observed, the first one being the more frequent. Real-time averaging was obtained by utilizing a sampling technique. This enabled a reduction of the system bandwidth to several hertz, allowing the use of low peak-power RF pulses (1 W), and low-speed chart recorders. Twenty-one recorded average returns are given, along with an interpretation of the recordings and a description of the measuring system. (Author)

A72-11809 # Energy spectra of sea waves from photographic interpretation. R. S. Kasevich, C. H. Tang, and S. W. Henriksen (Raytheon Co., Wayland, Mass.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 607-624. 16 refs.

An optical Fourier transform analysis of a photograph of the sea taken under a particular skylight irradiance has been shown to provide a quantitative description of the sea vector wave number spectrum. The functional relationship between the Fourier transform and wave number spectrum requires a knowledge of the skylight irradiance reflected from the sea surface to the aerial camera lens. A first order analysis of the geometric optics of the camera-sea surface-skylight indicates that the optical density of the aerial negative along the two orthogonal coordinate axes is related to the sea surface slope. If the average spatial variation of the optical density is linear, then a functional representation of the vector wave number spectrum is recorded in the Fourier transform photograph. Experimental evaluation of a number of Fourier transform photographs is in progress and a brief description of this work is presented. (Author)

A72-11810 # An experimental model for automated detection, measurement and quality control of sea-surface temperatures from ITOS-IR data. J. Leese, W. Pichel, B. Goddard, and R. Brower (NOAA, National Environmental Satellite Service, Washington, D.C.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 625-646. 11 refs.

A computer model was developed which contains all the segments of an automated operational procedure for obtaining sea-surface temperatures from satellite infrared (IR) data. An evaluation of this model during a five-week test period demonstrated the ability of the different software components to perform the detection, measurement, and quality control functions in the automated processing of raw data into sea-surface temperature values. Limitations in available ground truth data precludes the computation of accuracy based only on test comparisons of satellite IR temperatures and surface-based observations. A quantitative error

analysis of the Improved TIROS Operational Satellite (ITOS) system components, combined with test results on the model using real data, indicates that an RMS variation of less than 1 C in derived sea-surface temperatures should be possible using only IR data in regions where the temperature gradient is less than 2 C per 100 km. In regions where the temperature gradients are 2 to 4 C per 100 km, the inclusion of data from the visible channel to reduce cloud contamination errors should reduce the RMS variation to less than 1 C. Improvements may be needed in the earth location accuracy of ITOS data to achieve an RMS variation less than 1 C in regions where the temperature gradient is larger than 4 C per 100 km. (Author)

A72-11813 # Sea surface temperature mapping off the eastern United States using NASA's ITOS satellite. P. K. Rao, A. E. Strong, and R. Koffler (NOAA, National Environmental Satellite Service, Hillcrest Heights, Md.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 683-691. 7 refs.

High resolution (approximately 8 km) IR imagery from NASA's ITOS-1 satellite demonstrates the utility of synoptic sea-surface temperature information - 'horizontal oceanography.' The northern edge of the Gulf Stream, the slope and shelf waters display complex thermal characteristics with distinct temperature gradients separating these three water masses. It is pointed out that this type of information can be very useful for increasing our understanding of many physical phenomena occurring over the earth's oceans. M.M.

A72-11823 * # An orbiting multispectral scanner for overland and oceanographic applications. K. Peacock and R. J. Withrington (Bendix Corp., Aerospace Systems Div., Ann Arbor, Mich.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 2. Ann Arbor, University of Michigan, 1971, p. 889-903. Contract No. NASW-2119.

Description of the major features of a multispectral scanner designed to perform overland and oceanographic surveys from space. The instrument uses an image plane conical scanner and contains independent spectrometers for land and ocean applications. The overland spectrometer has a spatial resolution of 200 ft and has six spectral bands in the atmospheric windows between 0.5 and 2.4 microns. The oceanographic spectrometer has a spatial resolution of 1200 ft and possesses 24 spectral bands equally spaced and in registration over the wavelength range from 0.4 to 0.8 micron. A thermal band of 600-ft resolution is used with a spectral range from 10.5 to 12.6 microns. The swath width of the scan is 100 nautical miles from an altitude of 500 nautical miles. The system has two modes of operation which are selectable by ground command. The six bands of overland data plus the thermal band data can be transmitted, or the 24 bands of oceanographic data plus data from two of the overland bands and the thermal band can be transmitted. The performance is described by the minimum detectable reflectance difference and the effects of sun angle and target reflectivity variations are discussed. The sensitivity is related to the variation of the ocean reflectivity in the presence of chlorophyll and to typical agricultural targets. (Author)

A72-11857 * # Reflectance and transmittance characteristics of several selected green and blue-green unialgae. L. C. Gramms and W. C. Boyle (Wisconsin, University, Madison, Wis.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 1627-1650. 20 refs. Grant No. NGL-50-002-127.

Obtained reflectance properties of green and blue-green unialgae are evaluated for determining the feasibility of using selected wavelengths in differentiating between green and blue-green algae. The attempt is made to establish selected wavelengths and ratios that would delineate relative concentrations of the algal suspensions. The

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results should prove helpful in the selection of spectral bands usable in conjunction with multispectrum scanners for qualitative and quantitative studies of algae in bodies of water. M.V.E.

A72-11864 # Remote passive microwave sensing of the ocean surface. J. P. Hollinger (U.S. Navy, E. O. Hulburt Center for Space Research, Washington, D.C.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 1807-1817. 13 refs. Navy Contract No. WR 1-0075.

The important potential of all-weather determination of ocean surface wind fields by means of remote passive microwave sensing is discussed. The wind speed dependence of the microwave brightness temperature of the sea is interpreted as resulting primarily from small scale wave structure at wind speeds below about 15 to 20 m/sec and from the increasing coverage of sea foam at higher wind speeds. Measurements of these two effects are presented and the characteristics of each described separately. The two effects are combined to estimate the total microwave brightness temperature dependence of a wind driven sea as viewed from a satellite. Taken together the two effects allow the determination of ocean surface wind fields over the entire range of wind speeds. The sensitivity to wind speed increases with observational frequency and is most pronounced for horizontal polarization at larger incidence angles. (Author)

A72-11866 * # Microwave measurement of thermal emission from the sea. K. W. Gray, W. F. Hall, W. N. Hardy, G. M. Hidy, W. W. Ho, A. W. Love, M. J. Van Melle, and H. Wang (North American Rockwell Science Center, Thousand Oaks, Calif.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 1827-1845. 12 refs. Contract No. NAS1-10106.

Review of the results of some experimental and theoretical investigations of various limiting factors in microwave measurements of thermal emission from the sea, ranging from instrumentation to surface properties of the ocean. It is shown that absolute measurement of the thermal emission from the sea can be made at 2.69 GHz, with accuracies of better than plus or minus 1 K within the present state of microwave instrument development. The principal uncertainties on interpretation of such observations in terms of molecular temperature of the sea involve: (1) surface contamination such as oil slicks, (2) spray and foaming, (3) salinity variation, and (4) surface waves. M.V.E.

A72-11868 # Mathematical model for the relationship of radar backscattering cross sections with ocean scene and wind velocity. K. Krishen (Lockheed Electronics Co., Inc., Houston, Tex.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 1861-1877. 27 refs.

The mathematical model for the relationship between average scattering cross section, wind velocity, and fully developed seas was developed from NASA/MSC 13.3-GHz scatterometer data acquired over several sea states. This model is based upon the composite scattering theory. Results of this study indicate several predictable parameters that can be used for evaluating sea surface conditions and wind velocities. (Author)

A72-11869 # Ocean wave height measurements with a nanosecond radar. B. S. Yaplee, A. Shapiro, D. L. Hammond, E. A. Uliana (U.S. Navy, E. O. Hulburt Center for Space Research, Washington, D.C.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 1879-1893.

A radar system has been developed with a sufficiently narrow

pulse width to resolve the vertical wave structure of ocean waves. The nanosecond radar system was installed on the Chesapeake Light Tower located fifteen miles east of Virginia Beach, Virginia. The radar illuminated a 70 cm diameter spot on the ocean at normal incidence and three wave poles were placed in a delta configuration around the spot for ground truth measurements. A corner reflector was placed at the center of the antenna beam to calibrate the radar measurements both in range and amplitude. Wind conditions were monitored using the tower's anemometer. These ground truths were then used in relating the radar measurements to the actual sea conditions. The wave heights encountered ranged from two to six feet. The results of the radar measurements are presented and compared with the simultaneous wave pole measurements of the sea surface structure. (Author)

A72-11872 # The use of space-television images in the location of hydrospherical fronts. A. I. Babkov (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 1921-1927. 8 refs.

This paper discusses the possible use of images from space television in the location of hydrospherical fronts (temperature discontinuities in the sea). Use of such images depends upon existing interrelations between properties of the underlying surface and cloud distributions, since the development and characteristics of cloud distributions are related to the properties of temperature discontinuity zones in the ocean. We examined the cloud distributions over a temperature discontinuity front in the Sea of Japan. The data were obtained from television images taken from satellites ESSA-6 and ESSA-8. (Author)

A72-11882 # Determination of sea ice drift using side-looking airborne radar. J. D. Johnson and L. D. Farmer (U.S. Coast Guard, Applied Sciences Div., Washington, D.C.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 2155-2168. 12 refs.

Results of experimental applications of side-looking airborne radar (SLAR) are presented which show that, using SLAR imagery, individual ice floes can be identified by their size, shape, and surface characteristics, in addition to overall sea ice conditions. Results also show that single ice floes, as well as general ice masses, can be tracked to an accuracy of nearly one nautical mile. O.H.

A72-11885 # Multispectral analysis of aquatic ecosystems in the Chesapeake Bay. R. R. Anderson (American University, Washington, D.C.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 2217-2227.

Description of ongoing research in the use of remote sensing in wetland and shallow water portions of aquatic ecosystems. Multispectral photography and imagery has been obtained by NASA over the Chesapeake Bay. Results indicate that certain portions of the spectrum will best delineate plant communities in these areas and should be used in future studies. Data enhancement techniques are also useful. Coastal zone management decisions regarding the value of various wetlands to wildlife and estuarine productivity may be made using remote sensing techniques. (Author)

A72-14227 # Detailed sea-surface temperature analysis utilizing Nimbus HRIR data. F. M. Vukovich (Research Triangle Institute, Research Triangle Park, N.C.). *Monthly Weather Review*, vol. 99, Nov. 1971, p. 812-817. 11 refs. ESSA Contract No. E-236-69/N/.

A technique that reduces the effect of noise in the Nimbus High

Resolution Infrared Radiometer (HRIR) data and that yields sea-surface temperatures free of cloud interference has been developed. It allows a spatial resolution of about 20 n.mi. and the resulting HRIR temperature pattern compares well with ground truth data. A 1.0 C discrepancy was found between the modified HRIR data and the ground truth wherein the HRIR temperatures were lower than the ground truth values. HRIR data were corrected for attenuation by water vapor and carbon dioxide absorption. (Author)

A72-15563 Determination of the sea state from an aerial photograph (Détermination de l'état de la mer à partir d'une photographie aérienne). J.-P. de Loof and B. de Lagarde (Société Bertin et Cie., Paris, France). (*Association Technique Maritime et Aéronautique, Session, 71st, Ecole Nationale Supérieure des Techniques Avancées, Paris, France, May 10-14, 1971.*) *Association Technique Maritime et Aéronautique, Bulletin*, no. 71, 1971, p. 679-688; Discussion, p. 689-692. In French.

Discussion of the possibility of using the reflection at the water surface of the diffuse component of the natural light radiated by the sky-sun combination in order to determine the state of the sea surface. A laboratory study for the case of a unidirectional swell, which was monochromatic, and in perfectly diffused light, showed interesting properties of the densitometric curve obtained from the negative of the photograph. For this simplified case, the possibility of restoring the profile of the swell in a simple manner is shown.

F.R.L.

A72-16040 Wrench movements in the Baluchistan Arc and relation to Himalayan-Indian Ocean tectonics. M. Abdel-Gawad (North American Rockwell Science Center, Thousand Oaks, Calif.). *Geological Society of America Bulletin*, vol. 82, May 1971, p. 1235-1250. 35 refs.

Satellite photographs provide evidence that the structural discontinuity between the east-west-trending Makran Ranges and the north-south-trending Kirthar and Sulaiman Ranges of the Baluchistan Arc is among the world's major left-lateral shear belts. The Kirthar Sulaiman shear occurs at the junction of the Himalayan and Baluchistan arcs and may have influenced the development of the western Himalayan syntaxis. A similar belt of right-lateral shear is suggested at the junction of the Himalayan and Burmese arcs (eastern Himalayan syntaxis). Between the two extremes the Himalayan arc appears to be affected by gigantic tear faults cutting across the east-west-trending fold and thrust axes. The tectonic pattern suggests that these cross structures are zones of differential lateral movement within the crust related to linear features of sea-floor spreading in the Indian Ocean, the northward drift and underthrust of India beneath the southern edge of the Asian craton. (Author)

A72-17590 Review of the electrical properties of ice and HISS down-looking radar for measuring ice. K. Iizuka, V. K. Nguyen, and H. Ogura (Toronto, University, Toronto, Canada). (*Canadian Aeronautics and Space Institute, Aerospace Electronics Symposium, Toronto, Canada, Mar. 15, 16, 1971.*) *Canadian Aeronautics and Space Journal*, vol. 17, Dec. 1971, p. M-28 to M-33. 23 refs.

Brief review of some phases of the HISS (Holographic Ice Survey Systems) program aimed at the development of a down looking radar system specifically designed for the electromagnetic probing and measurement of sea ice and glaciers. Its operation is based on the principle of holographic imaging, and it represents a combination of conventional CW radar with side-looking radar. This radar is to consist of a large parabolic transmitting antenna and an array of receiving antennas. Preliminary tests are being conducted using a prototype in an anechoic chamber. The electrical properties of sea ice at low and at radio frequencies are discussed. M.V.E.

A72-17825 Image enhancement techniques for improving sea-ice depiction in satellite infrared data. J. C. Barnes, D. T. Chang, and J. H. Willand (Allied Research Associates, Inc., Concord, Mass.).

Journal of Geophysical Research, vol. 77, Jan. 20, 1972, p. 453-462. 8 refs. NOAA Contract No. E-67-70/N/.

The application of image enhancement to improve sea-ice depiction in satellite infrared data is investigated using Nimbus high resolution infrared radiometer (HRIR) measurements of the northern Canada-Greenland arctic region. The results of densitometric analysis indicate that although ice boundaries can be detected in HRIR film strips by identifying relative temperature differences, quantitative interpretation of the film strips cannot be obtained even when the accompanying gray-scale wedges are used as reference. Based on the densitometric analyses, experiments are performed to enhance the gray-scale contrast within the temperature range of interest. Through the experimentation, an improved scheme is developed such that the data are presented in a format from which accurate quantitative information can be visually derived and in which features of significance to sea-ice mapping are more clearly defined. Simulations of a five-level gray-scale depiction are given. (Author)

A72-19104 # The structure and intensity of turbulence in air over the sea. J. Warner (Commonwealth Scientific and Industrial Research Organization, Div. of Radiophysics, Sydney, Australia). *Royal Meteorological Society, Quarterly Journal*, vol. 98, Jan. 1972, p. 175-186. 17 refs.

Measurements of atmospheric turbulence have been made from an aircraft at heights in excess of 30 m over the open sea in convective situations. They are related to height, wind speed, heat flux and stability. The variation of the r.m.s. vertical velocity with height is examined for two different scaling systems. From calculations of the power spectra a length scale is derived for the vertical velocity fluctuations which is found to increase slowly with height. (Author)

A72-22312 * Experimental measurements of 2.25-cm backscatter from sea surfaces. R. W. Newton (Lockheed Electronics Co., Inc., Bay St. Louis, Miss.) and J. W. Rouse, Jr. (Texas A & M University, College Station, Tex.). (*Institute of Electrical and Electronics Engineers, Annual International Geoscience Electronics Symposium, 3rd, Washington, D.C., Aug. 25-27, 1971.*) *IEEE Transactions on Geoscience Electronics*, vol. GE-10, Jan. 1972, p. 2-7. 13 refs. Research supported by Remote Sensing, Inc.; Grant No. NsG-239-62.

Airborne 2.25-cm wavelength radar backscatter measurements of low-wind-speed sea conditions were obtained off the coast of Texas in January 1971. These data are compared with unpublished NASA 2.25-cm backscatter measurements recorded over the Atlantic in 1970. The two data sets were in general agreement and supported results previously reported by other authors which showed the absence of a saturation effect at this wavelength. Analyses of these data using computerized clustering techniques indicated that a wind speed measurement accuracy of 5-7 knots is an operational potential. (Author)

A72-22525 * Mapping sea-surface roughness using microwave radiometry. A. E. Strong (NOAA, National Environmental Satellite Service, Washington, D.C.). *Journal of Geophysical Research*, vol. 76, Dec. 20, 1971, p. 8641-8648. 21 refs. NASA-supported research.

Microwave radiometry data (1.55 cm) taken by aircraft over the Salton Sea have been corrected for viewing angle and atmospheric effects, rectified, and mapped. No fetch-limited conditions are observed along the upwind shore despite a 15 m/sec wind, which indicates that the radiometer is sensitive to the short wavelength surface roughness but not to the longer wavelengths. The brightness temperature field can be represented as a nearly linear function of the surface wind speed. (Author)

A72-23307 # Calculation of the depth of the sea in the coastal area on the basis of the interpretation of the surge (Calcul de

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la profondeur de la mer en zone cotière par interprétation de la houle). M. Guy. In: Internationale Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 2.

Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 753-765. 7 refs. In French.

The interpretation of aerial photographs of the neighborhood of the luminous solar reflection spot on the surface of the water makes it possible to analyze the transformations of the swell of the sea. A formula is presented for obtaining the depth in the refraction zone as a function of swell parameters. The procedure for the determination of the sea depth is illustrated in an example, giving attention to the limits of application of the method. G.R.

A72-24749 * The emissivity of sea foam at microwave frequencies. A. Stogryn (Aeroflex-General Corp., El Monte, Calif.). *Journal of Geophysical Research*, vol. 77, Mar. 20, 1972, p. 1658-1666. 11 refs. Contract No. NAS1-10633.

A consistent picture of the emission characteristics of sea foam at microwave frequencies has emerged from a survey of published radiometric measurements. The results are summarized, as functions of frequency and angle, by means of simple equations. Available data on the reflection properties of foam are also examined and shown to be qualitatively, but not quantitatively, in agreement with the radiometric results. (Author)

A72-25346 * Oceanographic applications of color-enhanced satellite imageries. K.-H. Szeikielda and W. F. Mitchell (NASA, Goddard Space Flight Center, Md.; U.S. Navy, Washington, D.C.). *Remote Sensing of Environment*, vol. 2, Feb. 1972, p. 71-76.

Black and white infrared imageries obtained from satellites over the oceans were transformed into color presentations. Investigations in different regions (Persian Gulf, Arabian Coast, Somali Coast and the Northwest Coast of Australia) revealed that temperature gradients and temperature differences of two degrees Celsius can be displayed by the color process from the imageries. This data display can be used for a rapid analysis of information obtained with an APT station. (Author)

A72-25348 * An observation of the Gulf Stream surface front structure by ship, aircraft, and satellite. G. A. Maul and D. V. Hansen (NOAA, Physical Oceanography Laboratory, Miami, Fla.). *Remote Sensing of Environment*, vol. 2, Feb. 1972, p. 109-116. 20 refs. NASA-supported research.

Evaluation of observations of surface temperature and salinity along the western edge of the Gulf Stream made from a ship and of concurrent temperature observations obtained by instrumented aircraft at six altitudes. The major feature along a five-kilometer line normal to the Stream's edge is a temperature gradient of about 0.75 C/kilometer within which are embedded two abrupt temperature increases of about 1.5 C. Temperature variations were compensated by salinity variations, yielding nearly constant density through the frontal zone; a sharp lateral current shear was associated with the thermohaline mixing region between the steps. The attenuation of surface temperature measured by the airborne radiometer was compared with a theoretical model. The analysis supports the view that a two-part correction technique is required: one part for bulk-skin temperature differences, and another for atmospheric attenuation of sea surface emission due to the mass and temperature of interfering gases. (Author)

A72-25763 # Global sea-surface temperature distribution determined from an environmental satellite. P. Krishna Rao, W. L. Smith, and R. Koffler (NOAA, National Environmental Satellite Service, Hillcrest Heights, Md.). *Monthly Weather Review*, vol. 100, Jan. 1972, p. 10-14. 14 refs.

A composite histogram method is used to objectively derive sea-surface temperature distribution from satellite radiation measure-

ments for the Northern and Southern Hemispheres. Comparisons with conventional observations yield root-mean-square differences of 2-3 K. Some of the differences can be accounted for by factors such as the coherent noise introduced by the onboard tape recorder, insufficient atmospheric attenuation corrections, and basic differences between the two types of temperature measurements. (Author)

A72-28533 Satellite altimetry using ocean backscatter. T. Berger (Cornell University, Ithaca, N.Y.). *IEEE Transactions on Antennas and Propagation*, vol. AP-20, May 1972, p. 295-309. 19 refs.

A model for the signal received when satellite altimetry pulses are scattered back by the ocean's surface is postulated and analyzed. The second-order statistics of the complex nonstationary random process appearing at the detector input are graphically and analytically displayed as a function of the sea state. The standard deviation of various altitude estimates derived by subsequent operations on the detector output are computed, too. The analysis applies both to ordinary short-pulse altimeters and to systems that employ pulse compression. (Author)

A72-29619 * # Objective analysis of sea-level winds and pressures derived from simulated observations of a satellite radar-radiometer and actual conventional data. L. M. Druryan (New York University; NASA, Goddard Institute for Space Studies, New York, N.Y.). *Journal of Applied Meteorology*, vol. 11, Apr. 1972, p. 413-428. 8 refs.

A computer-based procedure is developed that combines a field of simulated satellite-derived wind speeds with a limited amount of conventional surface data so as to recover the surface pressure field and the vector wind field over the North Pacific Ocean. Wind speeds are determined from an objective analysis of high spatial density ship observations in order to simulate the anticipated output of a proposed satellite-mounted radar-radiometer system. The simulated speeds are combined with the conventional network for various spatial distributions of ship data. The average rms departure of sea-level pressure fields analyzed by deleting from 75-94% of the available ship observations from the maximum data analysis is from 3.0-4.0 mb. Comparison of the wind components implied by the isobaric patterns to those of the withheld ship observations yields average rms differences of from 8.7-9.4 kt for a range of 75-94% data deletion. (Author)

A72-31238 # Remote detection techniques in oceanography (Le tecniche di rivelazione a distanza in oceanografia). M. Colacino (CNR, Istituto di Fisica dell' Atmosfera, Rome, Italy). In: Space activity in the field of ecology and earth resources; International Convention on Space, 12th, Rome, Italy, March 23-25, 1972, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1972, p. 211, 213-223. 13 refs. In Italian.

Discussion of the use of satellite telescopes in oceanic research and prospecting, permitting the collection of data on the state of the ocean, and its circulation, surface temperature, salinity, resources, life, and pollution. The activities of the Institute of Atmospheric Physics in oceanographic research by means of infrared equipment are described. In conclusion, a dual orientation of data acquisition is noted: from manned satellites and from automatic instruments on board applications satellites. B.B.M.

A72-31239 * # Global oceanic microwave anemometry - A planned space verification experiment. R. K. Moore (Kansas, University, Lawrence, Kan.) and W. J. Pierson, Jr. (New York University, Bronx, N.Y.). In: Space activity in the field of ecology and earth resources; International Convention on Space, 12th, Rome, Italy, March 23-25, 1972, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1972.

p. 229, 231-241. 13 refs. NASA-Navy-supported research.

Recent observations of the wind sensitivity of oceanic backscatter and temperature measurements are shown to have made it possible to design an experiment for verifying the potential use of an operational global satellite anemometer. The experiment is to be conducted with the Skylab in 1973, and its success may lead to the design and flight of an operational microwave scatterometer-radiometer instrument on a small satellite flying in a polar orbit sometime in the late 1970's. M.V.E.

A72-31673 # Radiative transfer in the earth's atmosphere-ocean system. II - Radiance in the atmosphere and ocean. G. W. Kattawar and G. N. Plass (Texas A & M University, College Station, Tex.). *Journal of Physical Oceanography*, vol. 2, Apr. 1972, p. 146-156. Contract No. N00014-68-A-0308-0002. Navy Project NR-83036.

A Monte Carlo method is used in calculating the upward and downward radiance for a realistic atmosphere-ocean system model. Typical radiance values are presented at six wavelengths from 0.40 to 0.65 microns, for three different solar angles, and for three different models of the ocean with various amounts of turbidity. The minimum value of the upward radiance just above the ocean surface, as a function of the nadir angle of observation, increases 640% from the turbid to the clear ocean model. Even at the top of the atmosphere, the increase is 40%. Thus, detectors in either aircraft or satellites should be able to obtain important information about the turbidity of the ocean. Other features shown in the results include the development with depth of the downward radiance both within and without the allowed cone into which radiation may enter the ocean from the sun and sky, the development of the asymptotic form for the downward radiance with depth, and the dependence of the radiance at various depths upon the turbidity of the ocean as well as the wavelength of the radiation. M.V.E.

A72-31674 * # A multispectral technique to determine sea surface temperature using Nimbus 2 data. W. E. Shenk and V. V. Salomonson (NASA, Goddard Space Flight Center, Greenbelt, Md.). *Journal of Physical Oceanography*, vol. 2, Apr. 1972, p. 157-167. 7 refs.

Three channels of the Nimbus 2 five-channel Medium Resolution Infrared Radiometer have been employed in the development of a technique to determine sea surface temperature. Two of the channels in the 0.2-4.0 and 6.4-6.9 micron spectral regions are used to indicate a cloud-free line of sight and the third, a high signal-to-noise window channel (10-11 microns), measures the equivalent blackbody temperature (Tbb) which is a function of the thermal emission from the sea surface and the intervening atmosphere. Equivalent blackbody temperatures and normalized reflectance thresholds were established using frequency distributions from the 6.4-6.9 and 0.2-4.0 micron channels, respectively, to determine the existence of cloud-free conditions. The window Tbb's were compared with ship ocean temperature measurements for a one-month period over the western North Atlantic. This comparison revealed a plus or minus 1.5 K dispersion about the mean difference between the ship temperatures and window Tbb's between 31-34 N. (Author)

A72-31786 Radar properties of non-Rayleigh sea clutter. G. V. Trunk (U.S. Navy, Naval Research Laboratory, Washington, D.C.). *IEEE Transactions on Aerospace and Electronic Systems*, vol. AES-8, Mar. 1972, p. 196-204. 23 refs.

Measurements of sea clutter at low grazing angles using high-resolution radar show that the probability density of envelope detected sea clutter is not Rayleigh. Using the composite surface scattering model, a special varying clutter density is proposed and is used to explain the non-Rayleigh nature of clutter. Since the clutter distribution has an enormous effect on the performance of a radar, the variation of the clutter densities with various radar parameters such as frequency, pulsewidth, and polarization is found. (Author)

A72-32622 # Remote sensing of coastal environments. V. Klemas (Delaware, University, Newark, Del.). In: Environmental progress in science and education; Institute of Environmental Sciences, Annual Technical Meeting, 18th, New York, N.Y., May 1-4, 1972, Proceedings. Mount Prospect, Ill., Institute of Environmental Sciences, 1972, p. 335-341. 16 refs. Contract No. N00014-69-A-0407.

The applicability of remote sensing to geological, oceanographic, and ecological investigations of the coastal zone is illustrated by a series of pertinent examples. Satellite and aircraft imaging platforms are considered. Emphasis is placed on the contribution that low altitude aerial photography with inexpensive cameras and filters can make to the mapping of bottom features, defining water boundaries and circulation patterns, detecting surface pollution slicks and subsurface effluents, finding fish, and imaging coastal vegetation. (Author)

A72-33169 BOMEX - An appraisal of results. R. G. Fleagle (Washington, University, Seattle, Wash.). *Science*, vol. 176, June 9, 1972, p. 1079-1084. 26 refs. NSF Grant No. GA-4091.

During the months of May, June, and July 1969 the observational phase of the Barbados Oceanographic and Meteorological Experiment (BOMEX) was carried out in the region of the tropical Atlantic to the east of the island of Barbados. Observations were made from satellites, 12 oceanographic ships, and 28 aircraft. The central objective of BOMEX was to compare vertical fluxes measured on the synoptic scale over the tropical ocean. The results obtained show that vertical vapor flux on the synoptic scale can be evaluated with reasonable accuracy in undisturbed periods by budget equations applied to both the atmosphere and the ocean. Aerosol distributions could be observed together with mesoscale structures in the planetary boundary layer. G.R.

A72-37924 # The potentialities of space technology in relation to oceanography and surface meteorology. N. Simmons (Ministry of Defence, London, England). *British Interplanetary Society, Journal*, vol. 25, Aug. 1972, p. 445-462. 6 refs.

Assessment of the surface observation requirements of oceanography and meteorology, and investigation of the possibility of fulfilling these requirements with the aid of means made available by space technology, including those of remote sensing and data collection by satellite. It is concluded that the possibilities held forth by space technology warrant a concerted further exploration effort of oceanographers together with space technologists. M.V.E.

A73-12773 * Aircraft measurements of microwave emission from Arctic Sea ice. T. Wilhelm, W. Nordberg (NASA, Goddard Space Flight Center, Greenbelt, Md.), J. Blinn (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.), W. Campbell (U.S. Geological Survey, Washington, D.C.), and A. Edgerton (Aerojet-General Corp., El Monte, Calif.). *Remote Sensing of Environment*, vol. 2, Oct. 1972, p. 129-139. 12 refs.

Measurements of the microwave emission from Arctic Sea ice were made with aircraft at 8 wavelengths ranging from 0.510 to 2.81 cm. The expected contrast in emissivities between ice and water was observed at all wavelengths. Distributions of sea ice and open water were mapped from altitudes up to 11 km in the presence of dense cloud cover. Different forms of ice also exhibited strong contrasts in emissivity. Emissivity differences of up to 0.2 were observed between two types of ice at the 0.811-cm wavelength. The higher emissivity ice type is tentatively identified as having been formed more recently than the lower emissivity ice. (Author)

A73-14804 Average return pulse form and bias for the S193 radar altimeter on Skylab as a function of wave conditions. W. J. Pierson, Jr. and E. Mehr (New York University, Bronx, N.Y.). In: The use of artificial satellites for geodesy; Proceedings of the Third International Symposium, Washington, D.C., April 15-17, 1971.

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Washington, D.C., American Geophysical Union, 1972, p. 217-226. 16 refs. Contract No. N63206-70-A-0075-0005.

A73-15777 Surface winds from sun-glitter measurements from a spacecraft. D. S. Webber (TRW Systems Group, Redondo Beach, Calif.). In: Remote sensing of earth resources and the environment; Proceedings of the Seminar-in-Depth, Palo Alto, Calif., November 8, 9, 1971. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1972, p. 93-100. 12 refs.

The use of satellite-based measurements of the sun glitter pattern (dancing highlights caused by the reflection of the sun from a roughened water surface) to estimate surface wind speeds is examined in terms of sensor requirements and the potential accuracy of the results. The wavelength, exposure, and resolution specifications of a suitable TV sensor employed on a sun-synchronous satellite are outlined, and attention is given to the additional capability of detecting oil spills by observation of the sea state. The accuracy of the wind-speed data is evaluated on the basis of estimated geometrical errors in the vidicon, radiance errors in the vidicon, and errors in the mathematical model. T.M.

A73-15778 Ocean color measurements utilizing a noon orbit for earth resources satellite applications. R. B. Gerding and K. R. Jenkin (TRW Systems Group, Redondo Beach, Calif.). In: Remote sensing of earth resources and the environment; Proceedings of the Seminar-in-Depth, Palo Alto, Calif., November 8, 9, 1971. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1972, p. 101-109.

Scene-illumination and area-coverage conditions are examined for an earth resources satellite with an ocean color sensor in a noon orbit (a near-polar orbit where the earth-sun line lies within the orbital plane). Graphs show trace shift as a function of altitude for various latitudes, and it is shown that the coverage can be increased by a factor of two (i.e., each geographical location will be overflown twice as often) as compared with a morning or afternoon orbit where the sun is to one side of the orbital plane. Effects on scene contrast and glitter interference are examined. T.M.

A73-15779 * High altitude remote spectroscopy of the ocean. P. G. White (TRW Systems Group, Redondo Beach, Calif.). In: Remote sensing of earth resources and the environment; Proceedings of the Seminar-in-Depth, Palo Alto, Calif., November 8, 9, 1971. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1972, p. 111-114. NASA-Navy-sponsored research.

An airborne spectrometer for measuring the spectral radiance characteristics of large bodies of water is described, and measured spectral signatures are analyzed to demonstrate the effects of sensor altitude. The contribution of backscattered light from the atmosphere becomes large at higher altitudes, particularly at the shorter wavelengths of the visible range. This reduces the contrast of the imaged scene and results in a substantial modification of the signal received by the spectrometer. The atmospheric effect on spectral data is described in some detail, and a technique is outlined for extracting pertinent information from high-altitude data. T.M.

A73-15913 Dependence of the spectrum of a radar signal scattered by sea surface on the size of the illuminated area and the strength of waves. A. A. Zagorodnikov. (*Radiotekhnika i Elektronika*, vol. 17, Mar. 1972, p. 477-487.) *Radio Engineering and Electronic Physics*, vol. 17, Mar. 1972, p. 369-377. 14 refs. Translation.

Relationships are given which can be used to calculate the Doppler spectral width of a radar signal reflected from a sea surface as a function of the dimensions of the illuminated region, scale of waviness, and emission factors. When the dimensions of the illuminated area are commensurable with or smaller than the average

length of the sea waves, the echo becomes a quasi-periodic nonstationary signal even if the waviness is homogeneous and stationary. T.M.

A73-17141 * Diffusion coefficients and current velocities in coastal waters by remote sensing techniques. W. P. James (Texas A & M University, College Station, Tex.). In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 352-361. 13 refs. Research sponsored by the Texas Water Quality Board; U.S. Environmental Protection Agency Grant No. WP-01383; Grant No. N5G-239-62.

This paper presents a simplified procedure for determining water current velocities and diffusion coefficients. Dye drops which form dye patches in the receiving water are made from an aircraft. The changes in position and size of the patches are recorded from two flights over the area. The data processing procedure requires that the ground coordinates about the dye patches be determined at the time of each flight. With an automatic recording coordinatograph for measuring coordinates and a computer for processing the data, this technique provides a practical method of determining circulation patterns and mixing characteristics of large aquatic systems. (Author)

A73-17605 # A hard look at oceans from space. J. R. Apel (NOAA, Atlantic Oceanographic and Meteorological Laboratories, Miami, Fla.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 9th, Washington, D.C., Jan. 8-10, 1973, Paper 73-11*. 10 p. 11 refs. Members, \$1.50; nonmembers, \$2.00.

A critical assessment is made of the problem of observing the oceans from spacecraft. Estimates are given of the directions that a satellite oceanography program might take during the next decade. Using both active and passive sensors in the visible, near- and thermal-infrared, and microwave frequency regions, it appears possible to determine several geophysical and biological variables of interest; these include the marine geoid, sea surface temperature, currents, wave heights and spectra, winds, storm surges, tsunamis, tides, ice, chlorophyll concentrations, red tides, sediment transport, and shallow bathymetric features. There are large benefits to marine and coastal interests and to weather forecasting from such information. (Author)

A73-17606 # Remote sensing application to the fisheries environment. W. H. Stevenson (NOAA, Fisheries Engineering Laboratory, Bay Saint Louis, Miss.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 9th, Washington, D.C., Jan. 8-10, 1973, Paper 73-12*. 3 p. Members, \$1.50; nonmembers, \$2.00.

Observations on the historical, present, and potential uses and activities of remote sensing from airborne and satellite platforms for fisheries resource assessment, utilization, and management are discussed. The gap between an increasing volume of fisheries related oceanographic data and the real-time utilization of these data, as well as the critical need for establishment of the relationship of environmental parameters to living marine resources are also discussed. Applicable segments of the NOAA mission, and that of its supportive elements, are briefly presented. (Author)

A73-17659 * Orbit analysis for coastal zone oceanography observations. E. F. Harrison and R. N. Green (NASA, Langley Research Center, Space Applications and Technology Div., Hampton, Va.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 11th, Washington, D.C., Jan. 10-12, 1973, Paper 73-207*. 8 p. Members, \$1.50; nonmembers, \$2.00.

A study has been performed to define the orbital characteristics of a satellite dedicated to monitoring the coastal zones of the United

States. The primary area of coverage is the east coast with secondary coverage of the west coast. Since no one orbital inclination fits both coasts, the inclination was determined by the east coast to be 63 deg. This inclination was found to give better coverage of the east coast than either its retrograde counterpart or a sun synchronous orbit. The two coasts require quite different orbits to maximize the coverage. The use of a small propulsive maneuver could be used to compromise the coverage between the two coastlines and change from one type orbit to the other. (Author)

A73-18281 * Mapping of atmospheric and sea ice parameters with an imaging microwave radiometer from the Nimbus 5 satellite. T. Wilheit, P. Gloersen, T. Schmugge, and W. Nordberg (NASA, Goddard Space Flight Center, Greenbelt, Md.). In: Annual Electro-Optical Systems Design Conference, 4th, New York, N.Y., September 12-14, 1972, Proceedings of the Technical Program. Chicago, Industrial and Scientific Conference Management, Inc., 1972, p. 63-67.

A73-22150 Analysis and interpretation of air-borne multi-frequency side-looking radar sea ice imagery. R. D. Ketchum, Jr. and S. G. Iooma, Jr. (U.S. Navy, Naval Oceanographic Office, Washington, D.C.). *Journal of Geophysical Research*, vol. 78, Jan. 20, 1973, p. 520-538.

Results of an air-borne side-looking radar experiment over the sea ice fields north of Alaska using a four-frequency radar system. The shorter-wavelength X band radar appears to have the greatest potential for sea ice study when more definitive information is required, such as mapping, distributions of stages of ice development, and fracture pattern analysis. Pressure ridge patterns can sometimes be identified when they are present on a low-backscatter background. The L band radar has potential value for mapping the areal distribution for surface topography. This wavelength does not receive discriminative backscatter from various ice types but sees only the more prominent topographic features, such as ridges and hummocks. The P band does not appear to have any characteristics that would make it valuable for sea ice mapping. Only the most prominent features, such as large fractures and floes, were imaged by this radar. (Author)

A73-22719 High-altitude photographs of the Oregon coast. D. F. Keene and W. G. Percy (Oregon State University, Corvallis, Ore.). *Photogrammetric Engineering*, vol. 39, Feb. 1973, p. 163-176. 14 refs. U.S. Department of the Interior Contract No. 14-17-0002-333; Contract No. N62308-70-C-0414.

Photographs were taken from 80,000 feet with black-and-white, color and color-infrared films in a study of the mouth of the Columbia River and the coasts to the southward in cooperation with the National Aeronautics and Space Administration, the U.S. Bureau of Commercial Fisheries and the U.S. Naval Oceanographic Office. In addition to standard mapping cameras, four 70-mm Hasselblad cameras were used equipped with panchromatic film and different filters. Studied were ocean color and color fronts, sea-surface banding, slicks, windrows over shallow banks, etc. The high-altitude photographs provide a 'big picture' perspective of the ocean with good resolution characteristics. Along with space imagery, they show oceanographic features related to productivity, pollution, coastal-zone management and ocean circulation enhancing one's understanding of the marine environment. (Author)

A73-25774 * Microwave radiometric observations of simulated sea surface conditions. M. J. Van Melle, H. H. Wang, and W. F. Hall (North American Rockwell Science Center, Thousand Oaks, Calif.). *Journal of Geophysical Research*, vol. 78, Feb. 20, 1973, p. 969-976. 10 refs. Research supported by the North American Rockwell Corp.; Contract No. NAS1-10106.

Review of the results of an experimental investigation of various factors affecting the surface properties of the ocean as seen by a

passive microwave radiometer operating at 2.66 GHz. The principal uncertainties in the absolute measurements of the thermal emissions from the sea in terms of molecular temperature are shown to stem from (1) surface contaminations, such as oil slicks, (2) spray and foam, (3) salinity variation, and (4) surface waves. The results of a variety of experiments conducted so far indicate that the direct contribution of surface films and spray to the thermal emission from the sea is considerably less significant than that of foam and waves.

M.V.E.

A73-26154 # Two-position scattering of radio waves by the sea surface at small slip angles (Dvukhpozitsionnoe rasseyaniye radiovoln poverkhnost'iu moria pri mal'kikh uglokh skol'zheniya). A. I. Kalmykov, A. S. Kurekin, I. E. Ostrovskii, and V. V. Pustovoiitenko (Akademiia Nauk Ukrainskoi SSR, Institut Radiofiziki i Elektroniki, Kharkov, Ukrainian SSR). *Radiofizika*, vol. 16, no. 2, 1973, p. 199-205. 7 refs. In Russian.

A73-26346 Sea ice observation by means of satellite. G. Wendler (Alaska, University, Fairbanks, Alaska). *Journal of Geophysical Research*, vol. 78, Mar. 20, 1973, p. 1427-1448. 32 refs. NOAA-supported research.

Detailed investigation of the ice conditions on a small area (about 120 x 150 km) of the Arctic Ocean off the shore of north Alaska, based on a computer-aided satellite imagery analysis. The results show the well known fact that offshore winds move the ice out and onshore winds bring it back. In the case analyzed, the wind is the most dominant force as far as the opening of the ice near the shore is concerned and thus is of practical importance in shipping and fishing along the coast. It is shown that satellites offer a unique tool for sea ice surveys. In spite of the high amount of cloudiness, detailed sea ice maps could be obtained by using computer technology.

M.V.E.

A73-26802 * Objective sea-level pressure analysis for data-sparse areas. L. M. Druryan (NASA, Goddard Institute for Space Studies, New York, N.Y.). *Journal of Applied Meteorology*, vol. 12, Mar. 1973, p. 255-263. 11 refs.

A computer procedure, described in an earlier study, uses the wind speed field near the ocean surface in combination with a small number of observations of pressure and wind velocity to specify the maritime sea-level pressure field. An improved version was used to analyze the pressure distribution over the North Pacific Ocean for eleven synoptic times in February 1967. Independent knowledge of the central pressures of lows is shown to reduce the analysis errors for very sparse data coverage. The application of planned remote sensing of sea-level wind speeds is shown to make a significant contribution to the quality of the analysis especially in the high gradient midlatitudes and for sparse coverage of conventional observations (such as over Southern Hemisphere oceans). Uniform distribution of the available observations of sea-level pressure and wind velocity yields results far superior to those derived from a random distribution. (Author)

A73-28787 # Project VEMNO - North Sea-Baltic measuring network. J. Thomas and S. Govaers. *Dornier-Past* (English Edition), no. 1, 1973, p. 24, 25.

The VEMNO development project represents a preliminary stage in the planned major project of a North Sea-Baltic Sea measuring network which will make possible the synoptical acquisition of oceanographical and meteorological parameters over large areas. The measuring station will consist of a buoy serving as support for the meteorological sensors. To examine the problems anticipated from fouling and corrosion, a rack containing test samples was moored near Heligoland. In the measuring network the data will be transmitted by using the European Meteostat satellite as a relay station.

F.R.L.

A73-29195 * Atmospheric effects on ocean surface temperature sensing from the NOAA satellite scanning radiometer. G. A. Maul (NOAA, Physical Oceanography Laboratory, Miami, Fla.) and M. Sidran. *Journal of Geophysical Research*, vol. 78, Apr. 20, 1973, p. 1909-1916. 17 refs. NASA-supported research.

Investigation of the effects of atmosphere state, nadir angle, cloud amount, cloud height, and random noise on ocean surface temperature sensing from the NOAA series satellites. The results obtained include the finding that a 10% cloud cover can introduce errors that range from 0.5 K to 4 K depending on cumuloform cloud height, which makes necessary a complete cloud elimination in the analysis. A correction scheme for cloud-free conditions is developed that is essentially free of bias. M.V.E.

A73-29197 Comments on the determination of the total heat flux from the sea with a two-wavelength radiometer system as developed by McAllister. K. B. Katsaros and J. A. Businger (Washington, University, Seattle, Wash.). *Journal of Geophysical Research*, vol. 78, Apr. 20, 1973, p. 1964-1970. 21 refs. NSF Grant No. GA-31317X; Contract No. N00014-67-A-0103-0014.

A73-29225 * # New estimate of annual poleward energy transport by Northern Hemisphere oceans. T. H. V. Haar (Colorado State University, Fort Collins, Colo.) and A. H. Oort (NOAA, Geophysical Fluid Dynamics Laboratory, Princeton, N.J.). *Journal of Physical Oceanography*, vol. 3, Apr. 1973, p. 169-172. 20 refs. NSF Grant No. GA-31588; Grant No. NGR-06-002-102.

A73-33356 Remote sensing in a circulatory survey of Boston Harbor. I. Y. Fitzgerald (NOAA, National Ocean Survey, Alexandria, Va.). In: Operational remote sensing; Proceedings of the Seminar, Houston, Tex., February 1-4, 1972. Falls Church, Va., American Society of Photogrammetry, 1972, p. 103-109; Discussion, p. 110.

Data acquisition for a circulatory survey of the Boston Harbor area was completed in October 1971. Operations were conducted by the National Ocean Survey (NOS) of the National Oceanic and Atmospheric Administration (NOAA). The basic tidal-current survey consists of the measurement of the horizontal movement of water and the processing of the acquired data. The direction and velocity of currents are measured with meters at selected locations and at various water depths for specific periods of time. F.R.L.

A73-33368 Remote sensing of the atmosphere and ocean. J. L. Goldman (Institute for Storm Research, Houston, Tex.). In: Operational remote sensing; Proceedings of the Seminar, Houston, Tex., February 1-4, 1972. Falls Church, Va., American Society of Photogrammetry, 1972, p. 301-309. 10 refs.

Summary of the measurement needs and recommendations formulated by the National Academy of Sciences with respect to nine atmospheric probing techniques in 1968, and review of the advances accomplished since. These techniques include lidar, radar and bistatic radio, infrared optical methods, microwave radiometric probing, acoustic methods, atmospherics, crossed-beam correlation methods, microwave line-of-sight propagation, and optical and infrared line-of-sight propagation. M.V.E.

A73-33728 Backscatter of millimeter waves from snow, ice, and sea ice. W. M. Sackinger (Alaska, University, Fairbanks, Alaska) and R. C. Byrd (Norway, Technical University, Trondheim, Norway). In: Propagation of radio waves at frequencies above 10 GHz; Proceedings of the Conference, London, England, April 10-13, 1973. London, Institution of Electrical Engineers, 1973, p. 219-228. 14 refs. Contract No. N00014-71-A-0385.

Review of the results of measurements performed in the laboratory in the 26-40 GHz frequency band and at 35 GHz in the field. Measurements were made on sea ice of varying salinity and

temperature in the laboratory. In the field, backscatter measurements were made on sea ice, fresh ice, and frozen ground under several different snow cover conditions. The results indicate that it is extremely difficult to obtain information on snow temperature, density, and morphology from radar backscatter data because of a wide variation in backscatter coefficient with angle. The laboratory and field measurements for sea ice both indicate that the penetration of millimeter waves is very small and that surface topography should be readily detectable. M.V.E.

A73-34946 # Radiometric measurements of temperature of the ocean surface - Improvement brought by use of a polarizing radiometer (Mesures radiométriques de température de surface de l'océan - Amélioration apportée par l'emploi d'un radiomètre polarisant). P. Lecomte, P. Y. Deschamps, J. C. Vanhoutte, and J. Lenoble (Lille I, Université, Villeneuve d'Ascq, Nord, France). In: The control of the terrestrial environment from space: International collaboration, methods and technologies; International Conference on Space, 13th, Rome, Italy, March 22-24, 1973, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1973, p. 273, 275-284. 7 refs. In French.

A73-34956 # The use of satellites for remote sensing of the sea surface (L'impiego dei satelliti per il telerilevamento della superficie del mare). V. B. Gasparo and P. L. Finocchi (Compagnia Industriale Aerospaziale S.p.A., Rome, Italy). In: The control of the terrestrial environment from space: International collaboration, methods and technologies; International Conference on Space, 13th, Rome, Italy, March 22-24, 1973, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1973, p. 401, 403-413. In Italian.

Discussion of the feasibility of using satellites for detecting and monitoring contamination of the Mediterranean Sea. The principal objectives pursued in carrying out surveillance with the aid of a satellite or space system are reviewed. A number of techniques which have been used in recent years for carrying out remote sensing with the aid of satellites are evaluated from the standpoint of complexity and resolution, including the use of multispectral scanners, the use of microwave passive radiometers, the use of image radar, and the use of side-looking radar. A.B.K.

A73-35153 On radar mapping of sea surface. S. D. Eshchenko and B. Sh. Lande. (*Radiotekhnika i Elektronika*, vol. 17, Aug. 1972, p. 1590-1597.) *Radio Engineering and Electronic Physics*, vol. 17, Aug. 1972, p. 1253-1258. 5 refs. Translation.

The results of a theoretical investigation of scattering of centimeter radiowaves by water surface under different hydrological and meteorological conditions are presented. Results of summer-sea experiments recording radar signals, reflected from the water surface, in the form of a planar radar image are given; these results were obtained under different hydrometeorological conditions. (Author)

A73-35364 The composite scattering model for radar sea return. K. Krishen (Lockheed Electronics Co., Inc., Houston, Tex.). In: Annual Southwestern Conference and Exhibition, 25th, Houston, Tex., April 4-6, 1973, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 81-88. 19 refs.

In this paper a composite scattering model suitable for explaining the behavior of measured scattering cross sections of the ocean surface is presented. With this scattering model, the spectrums of the small gravity, gravity-capillary waves are predicted for the NASA Manned Spacecraft Center (MSC) 13.3-GHz scatterometer data. The suitability of using the composite scattering model for the prediction of ocean surface wind and sea state from scatterometer observations is also shown. (Author)

A73-35486 * Microwave signatures of first-year and multi-

year sea ice. P. Gloersen, W. Nordberg, T. J. Schmugge, T. T. Wilheit (NASA, Goddard Space Flight Center, Greenbelt, Md.), and W. J. Campbell (U.S. Geological Survey, Tacoma, Wash.). *Journal of Geophysical Research*, vol. 78, June 20, 1973, p. 3564-3572. 12 refs.

A combination of remote sensing from an aircraft and simultaneous surface measurements have confirmed the feasibility of identifying old and new sea ice according to its emission of thermal radiation at wavelengths between 0.3 and 3 cm. Emissivity of first-year thick ice with a surface temperature of about 260 K is 0.95 or greater for wavelengths between 0.81 and 11 cm; the emissivity of multiyear ice is 0.8 at 0.81 cm and 0.95 at 11 cm, increasing monotonically in this wavelength interval. The ease with which multiyear ice can be distinguished from first-year ice using a passive microwave radiometer is demonstrated by comparing mosaics prepared both from photographs and images of 1.55-cm radiation.

(Author)

A73-35935 # Applications of ERTS data to oceanography and the marine environment. G. A. Maul (NOAA, Atlantic Oceanographic and Meteorological Laboratories, Miami, Fla.). *COSPAR, Plenary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper*. 17 p. 5 refs.

The multispectral scanner (MSS) on board the Earth Resources Technology Satellite (ERTS) has returned some remarkable imagery with applications to oceanography. Theoretical background for understanding the penetration and reflectance of light from the sea is briefly given for the MSS bands. Examples from the recent symposium on significant results include studies of sea ice, fisheries, charting, beach erosion, limnology, estuarine circulation, ocean features in the lee of islands, ocean currents, and internal waves. Several enhancement techniques are discussed and exemplified in the context of its application.

(Author)

A73-36024 # Prospects for physical oceanography from space. D. E. Cartwright (National Institute of Oceanography, Wormley, Surrey, England). *COSPAR, Plenary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper*. 11 p.

Barring applications to marine biology, glaciology, and near-shore processes, the principal areas of physical oceanographical research to which remote sensing from space is likely to contribute are: Lagrangian current tracking; global surface temperatures; wave height, roughness and wind parameters; and altimetry of static and dynamic features of the ocean surface, including tides. Present and possible future requirements and progress in these topics are reviewed and discussed.

(Author)

A73-36030 # Remote sensing of ocean color as an index of biological and sedimentary activity. G. C. Ewing (Woods Hole Oceanographic Institution, Woods Hole, Mass.). *COSPAR, Plenary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper*. 25 p. 9 refs.

The opportunities, accomplishments, and future promise of satellite-acquired data as a means of monitoring biological productivity of the world oceans is reviewed. A few examples of the current use of ERTS data are described. Some problems related to contamination of the data with irrelevant material are discussed. It is shown that, except at high levels of chlorophyll concentrations, the optical effects of biochromes are indistinguishable from those due to path radiance and surface glitter. These problems of photointerpretation must be resolved before remote sensing can fulfill its potential as a means for wise management of the biological marine resources of the sea.

(Author)

A73-36031 # A review of some possible uses of remote sensing techniques in fishery research and commercial fisheries. J. Joseph and M. R. Stevenson (Scripps Institution of Oceanography, La Jolla, Calif.). *COSPAR, Plenary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper*. 50 p. 11 refs.

It is shown that conventional approaches (nonremote sensing) do not provide all the necessary information required by fishery management, and that in many instances expanded data systems which provide coverage on a synoptic and real-time basis are needed. The current and future use of remote sensing techniques in fishery research is discussed, with emphasis on such problems as sampling and data storage, retrieval and reduction.

V.P.

A73-36134 # Earth satellite measurements as applied to sea ice problems. E. P. McClain (NOAA, National Environmental Satellite Service, Washington, D.C.). *COSPAR, Plenary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper*. 5 p. 21 refs.

Data from NOAA operational satellites, as well as from NASA satellites such as Nimbus and the new Earth Resources Technology Satellite (ERTS), are finding increasing operational and research use for sea ice surveillance and study. Methods are being developed to improve the mapping and monitoring of ice pack concentration, character, and condition from satellite observations in the visible, near-infrared, and thermal infrared parts of the spectrum. Recently acquired NOAA and ERTS measurements are higher in spectral and spatial resolution than previously available, and the newest Nimbus carries the first passive microwave imager in space. Examples of some of these newly available data and its applications are presented, and a brief discussion of future sensor systems expected to be of interest to sea ice researchers is given.

(Author)

A73-36642 * # Gulf Stream eddies - Recent observations in the western Sargasso Sea. P. L. Richardson, J. A. Knauss (Rhode Island, University, Kingston, R.I.), and A. E. Strong (NOAA, National Environmental Satellite Service, Washington, D.C.). *Journal of Physical Oceanography*, vol. 3, July 1973, p. 297-301. 9 refs. NASA-supported research; Contract No. N00014-68-A-0215-0003.

A cyclonic Gulf Stream eddy was observed in the western Sargasso Sea by satellite infrared measurements and later confirmed by ship measurements. Fourteen months of observations indicate that the eddy moved southwestward at an average rate of 1 mile per day. The evidence suggests that the eddy was absorbed by the Gulf Stream off Florida.

(Author)

A73-36643 # Some problems associated with wind drag and infrared images of the sea surface. J. R. McGrath and M. F. M. Osborne (U.S. Navy, Naval Research Laboratory, Washington, D.C.). *Journal of Physical Oceanography*, vol. 3, July 1973, p. 318-327. 24 refs.

It is argued that there should be a close connection between fluctuations in infrared images of the sea and fluctuations in wind drag on the sea. The critical regions of wind speed, temperature, and surface contaminant, where these fluctuations should be largest, are pointed out. Some examples are given of infrared ocean images and the problems associated with their interpretation.

(Author)

A73-38240 Remote sensing of the ocean. W. H. Munk, J. D. Woods, W. P. Birkemeier, C. G. Little, R. H. Stewart, and J. Richter. (*Inter-Union Commission on Radio Meteorology, Symposium on Waves and Turbulence in Stable Layers and their Effects on EM Propagation, 3rd, La Jolla, Calif., June 5-15, 1972.*) *Boundary-Layer Meteorology*, vol. 5, Apr. 1973, p. 201-209.

Methods of probing the physical structure of ocean waters from within the ocean, which are based on backscatter of ground waves are reviewed. The principles of probing by acoustic techniques, by lidar techniques, and of electromagnetic probing of the ocean surface are examined. Other possible methods based on scatter from the ocean surface are noted.

V.P.

A73-38243 Hydrodynamics of stratified fluids - The applicability of linear theory. R. S. Lindzen, L. N. Howard, A. McEwan, D. Delisi, and E. Gossard. (*Inter-Union Commission on*

Radio Meteorology, Symposium on Waves and Turbulence in Stable Layers and their Effects on EM Propagation, 3rd, La Jolla, Calif., June 5-15, 1972. *Boundary-Layer Meteorology*, vol. 5, Apr. 1973, p. 227-231. 14 refs.

A73-38593 # Buoy tracking of ocean currents. R. L. Molinari (NOAA, Atlantic Oceanographic and Meteorological Laboratories, Miami, Fla.). *American Astronautical Society, Annual Meeting, 19th, Dallas, Tex., June 19-21, 1973, Paper 73-144*. 15 p. 10 refs.

The use of free-drifting platforms to track ocean currents is discussed. The evolution of Lagrangian measurement techniques from ship-tracking to satellite-tracking of platforms is considered by describing specific drifter studies. Discussions of these studies include the uniqueness of the Lagrangian results, and other possible uses for the data. Future uses for buoy tracking are also suggested. (Author)

A73-38594 # On a dedicated oceanographic satellite. J. R. Apel (NOAA, Atlantic Oceanographic and Meteorological Laboratories, Miami, Fla.). *American Astronautical Society, Annual Meeting, 19th, Dallas, Tex., June 19-21, 1973, Paper 73-145*. 7 p. 6 refs.

By and large, satellite oceanography is confined to surface and near-surface phenomena. However, surface data taken from spacecraft can be appended with other, conventionally derived subsurface measurements of certain parameters in order to construct a more nearly three-dimensional view of the ocean. Sea-air interactions are considered together with currents, upwellings, deep-sea tides, sea-earth interactions, and water mass identification. Instruments and sensors are discussed, giving attention to the imaging ocean color/thermal infrared spectroradiometer, the high-precision radar altimeter, and the microwave coherent imaging radar. G.R.

A73-38595 # Infrared sensing of ocean surface temperature. G. A. Maul (NOAA, Atlantic Oceanographic and Meteorological Laboratories, Miami, Fla.). *American Astronautical Society, Annual Meeting, 19th, Dallas, Tex., June 19-21, 1973, Paper 73-146*. 16 p. 21 refs.

Remote sensing has provided oceanographers with a tool capable of acquiring quasi-synoptic global information on the near surface (less than 100 m) ocean environment. The discussion is limited to the infrared sensing of surface temperature. A single channel scanner such as used on Nimbus experimental meteorological satellites is briefly described. Infrared theory, airborne radiation thermometry, and single and multiband satellite data analysis techniques are examined. Ocean surface temperature mapping from space may soon be an operational product on a low spatial resolution scale. F.R.L.

A73-39843 # Two-dimensional statistic analysis of radar imagery of sea ice. A. A. Zagorodnikov, V. S. Loshchilov, and K. B. Chelyshev (Glavnoe Upravlenie Gidrometeorologicheskoi Sluzhby SSSR, Arkticheskii i Antarkicheskii Nauchno-Issledovatel'skii Institut, Leningrad, USSR). In: *International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1*. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 279-290. 7 refs.

A73-39863 * # Application of a pulsed laser for measurements of bathymetry and algal fluorescence. G. D. Hickman, J. E. Hogg, E. J. Friedman, and A. H. Ghovanlou (Sparcom, Inc., Alexandria, Va.). In: *International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1*. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 617-637. 14 refs. Research sponsored by the U.S. Navy, National Ocean Survey Engineering Development Laboratory, U.S. Geological Survey, and NASA.

The technique of measuring water depths with an airborne pulsed dye laser is studied, with emphasis on the degrading effect of some environmental and operational parameters on the transmitted and reflected laser signals. Extrapolation of measurements of laser

stimulated fluorescence, performed as a function of both the algal cell concentration and the distance between the algae and the laser/receiver, indicate that a laser system operating from a height of 500 m should be capable of detecting chlorophyll concentrations as low as 1.0 mg/cu m. V.P.

A73-39865 # Salinity surveys using an airborne microwave radiometer. J. F. Paris (Lockheed Electronics Co., Inc., Houston, Tex.). In: *International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1*. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 665-676. 10 refs.

An analysis technique developed makes it possible to determine the distribution of surface water temperature and salinity along the flight line from multifrequency microwave radiometer (MFMR) and IR radiometry (PRT-5) data taken along the flight track of the NASA 927 aircraft. In order to obtain the salinity of the water surface from MFMR measurements, the effects of a number of other parameter must be taken into account. A computer program was developed to analyse the MFMR and PRT-5 data and to produce profiles of water surface salinity and temperature along the aircraft flight track. The computer program was used with flight data acquired during a flight of the NASA 927 over the outflow of the Mississippi River into the Gulf of Mexico in November 1971. G.R.

A73-39885 # Time sensing and analysis of coastal waters. M. Nichols and M. Kelly (Virginia, University, Gloucester and Charlottesville, Va.). In: *International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2*. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 969-981. 9 refs. Contract No. N00014-72-C-0268.

Sequential photographs from aircraft and satellites provide a source of data for studying dynamic features of coastal waters. To quantitatively detect tonal changes, images in two or more frames must have proper registration and comparable tones - i.e., tones free of photographic difference and changes of solar illumination. Tonal difference is removed by normalizing successive time frames. Control points with stable reflectance are selected, their densities are measured in successive frames, differences are determined, and the resulting linear correction is applied to the density distribution of transient tonal areas of water. Once tones are brought to a common density reference, differences of image density in the same geographic area are determined between frames taken from time to time, and areas of equal change are delineated and further related to causal processes or impacts. (Author)

A73-39886 # Southern California coastal processes as analyzed from multi-sensor data. D. D. Steller, L. V. Lewis, and D. M. Phillips (North American Rockwell Corp., Downey, Calif.). In: *International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2*. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 983-998.

Laboratory analysis of multi-sensor imagery collected during a series of southern California remote sensor flights resulted in several new techniques for analyzing coastal effluent distribution and sediment transport. Digital and isolevel processing of infrared thermal scanner data shows detailed contours of surface thermal effluents and the effects of longshore currents on these effluents. Emside scanner derivative enhancements resulted in a technique for showing the distribution of suspended sediment and tracer dyes in the near-shore zone. Multicolor dyes dropped at various depths were detected, utilizing narrow-band filters and multispectral photography. Surface and subsurface current direction was determined by analyzing the diffusion of these dyes. (Author)

A73-39887 # A statistical-temporal image merging technique for automatic bathymetry applied to southern California coastal waters. D. T. Hodder and G. A. McCue (North American Rockwell

Corp., Downey, Calif.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 999-1016. 7 refs. Contract No. N00014-72-C-0149.

Description of an improved passive technique for automatic bathymetric plotting in turbid, relatively shallow coastal waters. Initially the technique uses narrower slicing (200-Å) bandpass interference filters than have heretofore been utilized in multi-spectral photography of coastal waters. This is done to reject all of the nonimage-forming (scattered) light for bottom photography. Coupled with this is an attempt to adequately characterize the water column by a modulation transfer function derived either from laser or photographic techniques. Finally, widely spaced repetitive imagery of identical sites under randomly varying conditions of the water column transmission properties were employed to linearly combine, by computer, film isodensity contours. These isodensity contours may be due to combinations of suspended sediment and bottom relief. The former are considered random variations, while the latter are relatively stable features. This statistical approach has yielded a superior estimate of actual depth contours, since the random sediment effects average out and the bottom features reinforce. (Author)

A73-39888 # Isothermal mapping of temperature patterns from thermal discharges in Italian coastal waters. D. Borgese, G. Dinelli, F. Parrini (Ente Nazionale per l'Energia Elettrica, Centro Ricerca Termica e Nucleare, Milan, Italy), D. T. Hodder, and D. D. Steller (North American Rockwell Corp., Downey, Calif.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 1017-1047. 5 refs.

The results of a combined airborne infrared survey and surface and subsurface in situ temperature measurements are presented. These measurements concern thermal discharge patterns from thermal electric power plants in coastal and estuarine waters. The techniques employed to collect and calibrate the 8- to 14- micron infrared scanner imagery and to produce water surface isothermal maps are described; a correlation of these data with near simultaneous in situ temperature measurements taken at the water surface shows a reasonable agreement. Waters are nearly isothermal at all depths, except the surface. On the other hand, the subsurface measurements demonstrate that the laminar flow nature of the heated waters across the surface initially masks the presence of unmixed colder waters at depth. Well beyond the point of discharge, when frictional forces have acted to reduce the speed of the heated surface waters, better mixing occurs. It is concluded that for practical applications a maximum and minimum in situ temperature of the water surface should be recorded for calibration purposes. In addition, a vertical temperature gradient should be determined in the water near the point of discharge. Preferably this should be done at several points, since the boundary change to the well-mixed zone should be abrupt. (Author)

A73-39889 # Remote measurement of water temperature by Raman scattering. C. H. Chang and L. A. Young (Avco Everett Research Laboratory, Everett, Mass.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 1049-1068. 30 refs. Contract No. N62269-72-C-0204.

Studies have been made of the remote measurement of subsurface seawater temperature by means of Raman scattering. Laboratory measurements of Raman spectra of water in the O-H stretching region show a shift to longer wavelength with increasing temperature, with increasing salinity, and with crossed polarizers in front of the light source and detector. A two-color temperature measurement may be made with a temperature sensitivity of 1%/deg C. Cross-polarized sensors at the same wavelength may be used at reduced sensitivity. The performance of an airborne Raman system has been evaluated. A statistical temperature precision of 0.2 C can

be achieved at a depth of three attenuation lengths using 6 joules from a laser airborne at an altitude of 50 m. The application of the technique to measurement of the depth of the upper mixed layer in the ocean is discussed. (Author)

A73-39890 # Satellite detection of upwelling and cold water eddies. A. E. Strong, R. J. DeRycke, and H. Stumpf (NOAA, National Environmental Satellite Service, Hillcrest Heights, Md.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 1069-1081. 14 refs.

Two interesting cold water features have been witnessed by NOAA environmental satellites during the past year. A sequence of one to five satellite images unveiled upwelling features off the Mexican Pacific coast during February 1971. During the summer of 1972 a well developed 'Tehuantepecer' was observed through ATS-3 sun-glint information to be the driving force for this upwelling. Cold eddies have been tracked for several years off Cape Hatteras as they move southwestward in the Sargasso Sea toward Cape Kennedy, Florida. Not only can they be monitored by the satellite's infrared sensors, but at times cooler surface waters suppress cloud cover to reveal their location. (Author)

A73-39891 # Relationship between sea wave parameters and the spectra of aerial photography and radar imagery of sea surface. A. A. Zagorodnikov, V. S. Loshchilov, and K. B. Chelyshev (Glavnoe Upravlenie Gidrometeorologicheskoi Sluzhby SSSR, Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut, Leningrad, USSR). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 1083-1091. 9 refs.

Algorithms relating sea wave spectra with two-dimensional spectra of aerial photo pictures and radar imagery of the sea surface are discussed. Examples show how different parameters of sea waves can be obtained by means of two-dimensional and one-dimensional spectra of sea surface imagery. (Author)

A73-40142 Improvements brought to the measurement of the ocean surface temperature by utilization of a polarizing infrared radiometer (Améliorations apportées à la mesure de la température de surface de l'océan par l'utilisation d'un radiomètre infrarouge polarisant). P. Lecomte, P. Y. Deschamps, and J. C. Vanhouette (Laboratoire d'Océanographie Physique du Muséum, Paris; Lille I, Université, Villeneuve d'Ascq, Nord, France). *Applied Optics*, vol. 12, Sept. 1973, p. 2115-2121. 6 refs. In French. Research supported by the Centre National pour l'Exploitation des Océans.

A73-40817 # Radio techniques applied to oceanography and earth science - Oceanic wind measurement and overland imaging as examples. R. K. Moore (Kansas, University, Lawrence, Kan.). *COSPAR, Plenary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper. 12 p. 32 refs.*

Review of some current and developing radar applications to oceanography and earth sciences. In particular, two examples of such applications are discussed: (1) the use of poor-resolution radiometer-scatterometer devices in meteorology over the oceans, and (2) fine-resolution imaging radar to be used for land observation and mapping. M.V.E.

A73-41333 # Remote sounding of water surface conditions from aboard artificial satellites. V. V. Milent'ev and Iu. I. Rabinovich (Glavnaia Geofizicheskaya Observatoriya, Leningrad, USSR). In: Space research XIII; Proceedings of the Fifteenth Plenary Meeting, Madrid, Spain, May 10-24, 1972. Volume 1. Berlin, East Germany, Akademie-Verlag GmbH, 1973, p. 105, 106.

The observation of sea roughness by means of microwave radiation measurements from aboard artificial satellites is shown to

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be possible. The drafting of a temperature chart of the Caspian Sea based on data of microwave radiation at 3.2 cm is reported. M.V.E.

A73-41634 Oceanographic analysis of orbital photographs of the upper Gulf of California. S. P. Vonder Haar and R. O. Stone (Southern California, University, Los Angeles, Calif.). *Photogrammetria*, vol. 29, Apr. 1973, p. 45-61. 12 refs. Contract No. NOAA-14-17-0002-436.

A series of photographs of the upper Gulf of California taken during orbital flights made in the interval between June 1965 and March 1969 were examined in order to determine specific oceanographic phenomena that might be identified on the imagery. The scale of the photographs is discussed together with photographic data and the approaches used in the investigation. Details of the oceanographic analysis are considered, giving attention to circulation systems, biological activity, turbidity, sea-surface state, cloud lines, upwelling, standing waves, and aspects of near-shore bottom topography. G.R.

A73-41832 * Two frequency radar interferometry applied to the measurement of ocean wave height. D. E. Weissman (Hofstra University, Hempstead, N.Y.). *IEEE Transactions on Antennas and Propagation*, vol. AP-21, Sept. 1973, p. 649-656. 8 refs. Grant No. NGR-33-209-002.

Description of a technique for measuring the rms wave height averaged over an area of the sea that is much greater than any horizontal scale of the surface waves. The measurement method involves a nadir looking radar that transmits and receives two continuous monochromatic signals simultaneously. Signal processing at the receiver requires the computation of a correlation function which is shown to depend only on the statistical rms surface elevation of specular points and not on the temporal or spatial frequency spectrum of the wave height or slope. Laboratory measurements have been conducted on wind driven waves, and the measured correlation function compares favorably with the underlying theory. M.V.E.

A73-42057 The determination of surface temperature from satellite 'window' radiation measurements. W. L. Smith and P. K. Rao (NOAA, National Environmental Satellite Service, Hillcrest Heights, Md.). In: Symposium on Temperature, 5th, Washington, D.C., June 21-24, 1971, Proceedings. Part 3. Pittsburgh, Instrument Society of America, 1972, p. 2251-2257.

This paper discusses the specification of sea surface temperature from satellite measurements of the earth's radiance in the 3.7 and 11 micron atmospheric window spectral regions. Observational results are presented which demonstrate the relative accuracies of sea surface temperature specification with each type of window measurement. The accuracy is limited by the existence of clouds within the instrument's field of view. Theoretical results are presented which were obtained from a recently developed algorithm for computing surface temperature from simultaneous 3.7 and 11 micron window measurements when partial cloudiness exists within the instrument's field of view. This multispectral window technique will enable reliable specification of sea surface temperature on small horizontal scales except in overcast regions. (Author)

A73-42726 * Suspended sediment observations from ERTS-1. V. Klemas, J. F. Borchardt, and W. M. Treasure (Delaware, University, Newark, Del.). *Remote Sensing of Environment*, vol. 2, no. 4, 1973, p. 205-221. 14 refs. Contracts No. N00014-69-A-0407; No. NAS5-21837.

Satellite imagery from four successful ERTS-1 passes over Delaware Bay during different portions of the tidal cycle are interpreted with special emphasis on visibility of suspended sediment and its use as a natural tracer for gross circulation patterns. The MSS red band (band 5) appears to give the best contrast, although the sediment patterns are represented by only a few neighboring shades of grey. Color density slicing improves the differentiation of turbidity levels. However, color additive enhancements are of limited

value since most of the information is in a single color band. The ability of ERTS-1 to present a synoptic view of the surface circulation over the entire bay is shown to be a valuable and unique contribution of ERTS-1 to coastal oceanography. (Author)

A73-42731 Statistical comparison of airborne laser and stereophotogrammetric sea ice profiles. S. G. Tooma, Jr. and W. B. Tucker (U.S. Navy, Naval Oceanographic Office, Washington, D.C.).

Remote Sensing of Environment, vol. 2, no. 4, 1973, p. 261-272. 9 refs.

During August, 1971, airborne laser profiling data and stereo-photographs were collected over the Lincoln Sea north of Greenland. The techniques used and the results obtained from a statistical comparison of the laser and stereophotogrammetric sea ice profiles collected on that mission are reviewed. Comparison of laser and stereo profiles showed agreement in the elevations of identifiable features to approximately 23 cm. Comparison of Fourier amplitude spectra derived from the profiles showed best agreement for surface wavelengths between 7.6 and 45.7 m (total sample length was about 450 m), but was limited in part by the laser response time. Cross-correlations between profile records subjected to comb filters verified the indications of the amplitude spectra comparisons and showed cross-correlation coefficients as high as 0.83 for data at surface wavelengths of 6.1 to 91.4 m. (Author)

N70-16237*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

OCEAN CURRENT AND SEA SURFACE TEMPERATURE OBSERVATIONS FROM METEOROLOGICAL SATELLITES

Gunter Warnecke, Larry M. McMillin (Allied Res. Associates, Inc., Concord, Mass.) and Lewis J. Allison (Washington Nov. 1969 50 p refs)

(NASA-TN-D-5142) Avail: CFSTI CSCL 08C

Television and infrared sensing techniques utilized by meteorological satellites provide a very useful tool for oceanographic research. Satellite television pictures of cloud patterns overlying thermally different oceanic boundaries reveal significant features of sea surface temperature distribution. Nimbus II High Resolution Infrared Radiometer (HRIR) data which is sensitive in the 3.4 to 4.2 microns were derived from nighttime satellite radiance measurements in the absence of clouds. Comparisons with observations from low flying radiometer-equipped aircraft confirmed good absolute sea surface temperature measurements from the satellite radiometer if 3 deg to 4 K corrections for atmospheric attenuation and other losses were applied. Sea surface temperature discontinuities such as the North Wall of the Gulf Stream have been located consistently within 10 kilometers of the positions indicated by the airplane radiation data. With present techniques, primarily designed for meteorological purposes, the Gulf Stream boundary has been seen, at least in significant parts in about 50 out of 175 days. Similar results have also been obtained in analyses of the Agulhas Current boundary, the boundary between the Brazil and Falkland Currents and the Kurishio - Oyashio mixing region. Author

N70-18106*# Texas A&M Univ., College Station. Dept. of Oceanography.

OCEANOGRAPHY USING REMOTE SENSORS Final Report, Jun. 1966 - 15 Dec. 1968

Luis R. A. Capurro 15 Jan. 1969 109 p refs Sponsored by NASA

(Contract Nonr-2119(04))

(NASA-CR-107898; AD-682939; REF-69-2F) Avail: CFSTI CSCL 08J

Airborne tests of multispectral remote sensors were conducted on eight occasions during July 1966 to September 1968 over the Mississippi Delta area and Eastern Gulf of Mexico to determine their usefulness in surveying river, coastal and deep-sea phenomena.

Four of these tests were supported concurrently by oceanographic research vessels, passive remote sensors, including metric cameras, infrared imagers and microwave radiometers, were flown at 1,500, 5,000, 10,000 and 50,000 feet above sea level. Studies into the relationship between low cloud development and horizontal anomalies in the sea surface temperature field and studies into basic microwave research have been conducted. The following features of the Mississippi River were surveyed by remote sensors: (1) location of surface frontal zones of convergence, (2) determination of surface water mass type, (3) small scale pattern of mixing, (4) location of internal waves and (5) general outflow pattern shape and extent.

Author (TAB)

**N70-18317# RAND Corp., Santa Monica, Calif.
MEASUREMENT OF OCEAN WAVES IN A SATELLITE PHOTOGRAPH**

L. M. Libby, W. F. Libby (Calif. Univ., Los Angeles), and S. S. Lawrence (Calif. Univ., Los Angeles) Oct. 1969 10 p refs
(AD-696492; P-4230) Avail: CFSTI CSCL 8/3

Apollo 6 photographs of the surface of the ocean, made within two hours of noon solar time are found to show wave structure of the sea with remarkable clarity. The wave length distribution has been measured from about 1000 waves in a single photograph of about 10,000 sq mi area. With better photographic definition wave height could probably also be measured from deformation of edges of cloud shadows. Using this method it would be possible to measure wave length and wave height distributions daily of all oceans, with a polar orbiting satellite carrying a television camera.

Author (TAB)

**N70-26126*# Massachusetts Inst. of Tech., Cambridge.
THE TERRESTRIAL ENVIRONMENT: SOLID-EARTH AND OCEAN PHYSICS**

Washington NASA Apr. 1970 153 p refs
(Contract NAS12-2180)
(NASA-CR-1579) Avail: CFSTI CSCL 08F

CONTENTS:

1. INSTRUMENTATION 35 p refs
2. OCEAN PHYSICS 18 p refs
3. SHORT-TERM DYNAMICS OF THE SOLID EARTH 26 p refs
4. LONG-TERM DYNAMICS OF THE SOLID EARTH 35 p
5. INTERACTION WITH OTHER DISCIPLINES AND PROGRAMS 12 p
6. DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS 14 p refs

**N70-26128*# Massachusetts Inst. of Tech., Cambridge.
OCEAN PHYSICS**

In its The Terrestrial Environ. Apr. 1970 18 p refs

CSCL 08J

Various sensors and systems for measuring the properties of the ocean from satellites are assessed, and the peculiar suitability of certain orbit configurations to meet special scientific needs is discussed. The point is stressed that the physical sea surface is not equipotential; it is the difference of a few dynamic meters between the physical sea surface and the geoid that is the oceanographer's concern. An orbiting altimeter is suggested for quantitative semidiurnal observation of the whole world ocean; however, the results are dependent on the height resolution technically possible. The problems involved in measurement, data analyses, and technology are examined in terms of the geoid, general circulation, low frequency phenomena, wave motion, ocean verification sites, precise position and tracking, and ocean transport

and diffusion. Possible programs are proposed and recommendations for improving the capabilities of radar altimeters are made.
M.G.J.

**N70-26957# Environmental Science Services Administration,
Washington, D.C. National Environmental Satellite Center.**

APPLICATIONS OF ENVIRONMENTAL SATELLITE DATA TO OCEANOGRAPHY AND HYDROLOGY

E. Paul McClain Jan. 1970 16 p refs
(ESSA-NESCTM-19) Avail: CFSTI

Techniques for large-scale mapping of sea surface temperatures in clear and partly cloudy regions are being developed with the aid of high-resolution infrared data from Nimbus satellites. Digitized television pictures from the ESSA operational satellites and Applications Technology Satellites are being studied in conjunction with the relation between sunglint patterns and the ocean wave spectrum and low-level wind stress. New methods for the mapping of major snow and ice boundaries from satellite altitude have been devised and are being tested.

Author

N70-27958# Radio Corp. of America, Princeton, N.J. Astro Electronics Div.

PASSIVE MICROWAVE MEASUREMENTS OF SEA SURFACE TEMPERATURE Final Report

Don G. Shipley and Kenneth J. Torok Dec. 1969 408 p
(Contract N00014-69-C-0245)
(AD-702044; AED-R-3525) Avail: CFSTI CSCL 8/10

RCA Astro-Electronics conducted a field experiment to verify a theoretical approach toward remote sensing of sea surface temperature using passive microwave radiation. There is a correspondence between the radiometric temperature of the sea and its thermometric temperature. This correspondence is influenced by the horizontal and vertical emissivity, the incidence angle at which the radiometric measurement is being made, contaminants on the water surface, and by the sea surface roughness. The experiment addressed itself to two basic questions: (1) Can one measure the vertically and/or horizontally polarized microwave radiometric emissions from the sea water and obtain an accurate measure of the thermometric temperature. (2) Can one also make a determination of sea state from such measurements. The radiometric measurements were made from North Island of the Chesapeake Bay Bridge and Tunnel District. The bulk of the microwave measurements were

N70-29756# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

TRANSACTIONS OF STATE OCEANOGRAPHIC INSTITUTE: COLLECTION OF ARTICLES

A. N. Kryndin et al 4 Oct. 1968 216 p refs Transl. into ENGLISH from Tr. Gos. Okeanogr. Inst. (Moscow), 1964 p 5-140
(AD-683475; FTD-MT-24-241-68) Avail: CFSTI CSCL 8/10

Contents: Seasonal and Interannual variations in ice conditions and position of the edge of the ice in the far eastern seas in relation to peculiarities of atmospheric circulation; Method of precomputation of iciness of the sea of Okhotsk and Gulf of Tatar in the spring period; The possibility of forecasting the expansion of ice along western shores of the central Caspian Sea region; Iciness of the Davis strait; The periodicity of variations in iciness of the Baltic Sea; Aerial photography of ice drift in the sea. TAB

**N70-30748*# Techtran Corp., Glen Burnie, Md.
EFFECT OF ANISOTROPY OF THE REFLECTION FROM THE UNDERLYING SURFACE ON DETERMINATION OF THE FLOW OF OUTGOING SHORTWAVE RADIATION ACCORDING TO MEASUREMENTS FROM A SATELLITE**

K. S. Shifrin et al *In its Satellite Meteorology*, No. 221 Jun. 1970 p 172-182 refs
Avail: CFSTI CSCL 04B

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The outgoing shortwave radiation (OSR) fields over snow and agitated seas is calculated. Formulas characterizing the increase in the sensitivity of the OSR field to the type of reflection indicatrix B with the growth of the albedo, are obtained. The OSR flows are practically independent of the type of B. A quantitative evaluation of the applicability of the Lambertian system of conversion from the brightness to the flow for the surface with arbitrary B and Albedo A is given. It shows that the greater is A the more rigid the requirements are presented to value B. With the exception of small regions of angles, the Lambertian system is applicable to the watery underlying surface and is not applicable to the snow surface

Author

N70-30747* Techtran Corp., Glen Burnie, Md.
DETERMINATION OF WIND VELOCITY AND WAVES ON THE SEA BY MEASURING THE SOLAR GLITTER PARAMETERS FROM SATELLITES
 K. S. Shifrin et al. *In its* Satellite Meteorology, No. 221 Jun. 1970 p 183-191 refs
 Avail: CFSTI CSCL04B

It is confirmed that it is possible to obtain not more than three gradations of wind velocity above the oceanic surface in the 0 to 15 m/sec. range. The measurement of wind direction and also velocities greater than 15 m/sec. is impossible by this method. It is necessary to have on the satellite a system, making it possible to measure the radiation, coming from the given point in two (or several) prescribed directions. A reliable method, with which it is possible to separate the cases of cloudless atmosphere in the measurements of the solar glitter from a satellite is developed. Aircraft measurements were made of the solar glitter at various wind velocities and sun elevations.

Author

N70-33678# System Development Corp., Santa Monica, Calif.
NATIONAL DATA PROGRAM FOR THE MARINE ENVIRONMENT, VOLUME 1, PHASE 2 Final Report
 31 Jul. 1969 517 p refs
 (Contract N00014-67-C-0559)
 (AD-699125; TM-4023/005/OO) Avail: CFSTI CSCL5/2

Contents: Description of the current marine data network. Analysis of current and future requirements. Delineation of priority marine data and products. Requirements and impact of technological change on marine data management. Evaluation of alternatives for improved marine data management and summary of technical development plan.

TAB

N70-34781* Scientific Translation Service, Santa Barbara, Calif.
ESSAY OF AN OCEAN-MORPHOLOGICAL INTERPRETATION OF SATELLITE PICTURES [VERSUCH EINER MEERESMORPHOLOGISCHEN DEUTUNG VON SATELLITEN-LÜFTBILDERN]
 E. Haase et al. Washington NASA Aug. 1970 29 p refs
 Transl. into ENGLISH from Deut. Hydrograph. Z. (Hamburg), v. 22, no. 5, 1969 p 193-204
 (Contract NASw-2035)
 (NASA-TT-F-13159) Avail: CFSTI CSCL08J

For some time, satellite pictures have been used to evaluate land masses. It has been generally assumed that in such pictures the oceans are shown by a uniform and undifferentiated black color. However, it was found that on some of these photos of the oceans, greyish shades were clearly visible. This led to the assumption that one is confronted here primarily, or at least secondarily, by a correspondence with submarine structures and, therefore, satellite photos could perhaps also be evaluated in an oceanomorphological way. In order to test such a possibility, 27 satellite photos out of a collection of pictures were compared with

the respective sea-charts and other data. In some instances, amazing correspondence of certain greyish hues with the known substratal forms became visible. So far, only vague statements can be made regarding other regions. At this point, it cannot as yet be decided whether and how extensive a primary or secondary connection exists. The necessary technical data for the evaluation of such satellite photos, concerning the receiving and transmitting procedures is summarized.

Author

N70-35009# Consiglio Nazionale delle Ricerche, Rome (Italy). Ist. di Fisica dell'Atmosfera.
LIGURIAN SEA SURFACE TEMPERATURE MEASUREMENTS WITH INFRARED RADIOMETER (PRT-5) [MISURE DELLA TEMPERATURA SUPERFICIALE DEL MAR LIGURE MEDIANTE RADIOMETRO INFRAROSSO (PRT-5)]
 M. Colacino Apr. 1969 33 p refs In ITALIAN
 (IFA-SR-25) Avail: CFSTI

Surface temperature measurements for February 1969, in the Ligurian Sea, were taken from an aircraft by using a portable infrared radiometer (PRT-5). The factors that cause errors in the measurements are discussed, and the isothermals resulting from the survey are shown. It is concluded that this is an efficient technique for data acquisition of surface temperatures for synoptic use.

Transl. by F.O.S.

N70-35160# Istituto di Fisica Dell'Atmosfera, Rome (Italy).
SEA-SURFACE TEMPERATURE MEASUREMENTS BY INFRARED RADIOMETER (PRT-5) [MISURA DELLA TEMPERATURA SUPERFICIALE DEL MARE MEDIANTE RADIOMETRO INFRAROSSO (PRT-5)]
 M. Colacino and E. Rossi May 1969 45 p refs In ITALIAN-ENGLISH summary
 (IFA-SR-27) Avail: CFSTI

After a brief description of the Barnes PRT-5 radiometer, and of its possible use for sea-surface temperature measurement, the results of an oceanographic survey during April 1969, in the Tyrrhenian Sea are presented. The data obtained by radiometer are matched with those obtained from dip bucket measurements, using a statistical method. Satisfactory agreement between the two series of values was found.

Author

N70-35259# Hokkaido Univ., Sapporo (Japan).
ON THE CORRELATION OF SEA ICE CONSTRUCTION TO RADAR PATTERN
 Tamotsu Ishida and Nobuo Ono *In its* Low Temp. Sci., Ser. A 1969 p 317-325 refs In JAPANESE; ENGLISH summary
 Avail: CFSTI

Studies of drift ice on the shores of the Sea of Okhotsk in Japan were carried out by use of a sea ice radar system. Drift ice flow vectors were determined from successive oblique aerial PPI photographs and sea ice construction charts were drawn. The correlation of sea ice construction to radar pattern was investigated in comparison with photographs. A-scope data along the same azimuth were analyzed concentrating on the number of echo pulses at certain intervals. It is clear by comparison with sea ice construction charts that the numbers of echo pulses are related to the size of floes. Radar cross section, target height, and reflecting efficiency of drift ice were determined from A-scope data. A distribution chart of the number of echo pulses is presented.

Author

N70-35569# Istituto di Fisica dell'Atmosfera, Rome (Italy).

SEA-SURFACE TEMPERATURE MEASUREMENTS BY INFRARED RADIOMETER (PRT-5): INFLUENCE OF THE VIEW ANGLE [MISURA DELLA TEMPERATURA SUPERFICIALE DEL MARE A MEZZO DI RADIOMETRO (PRT-5): INFLUENZA DELL'ANGOLO DI INCLINAZIONE]
M. Colacino, E. Rossi, and F. M. Vivona May 1969 39 p refs
In ITALIAN; ENGLISH summary
(IFA-TR-26) Avail: CFSTI

The influence of the view angles of radiometer on the sea-surface temperature measurements is examined. The measurements carried out in the oceanographic survey during April 1969 and the results obtained with statistical methods are presented. The results are considered in good agreement with data previously obtained. Author

N70-36303# Hawaii Inst. of Geophysics, Honolulu.
FLIGHTS WITH AIRBORNE RADIATION THERMOMETERS IN HAWAIIAN WATERS
Klaus Wyrki Feb. 1970 36 p refs
(Contract Nonr-3748(08))

(AD-704538; HIG-70-5) Avail: CFSTI CSCL 8/10

During August 1968 nine flights with airborne radiation thermometers were made over the waters west of the island of Hawaii with the purpose of locating the cold spots formed in the centers of cyclonic eddies. Such cold spots were observed and found to be drifting westward at rates of between 2 and 7 miles per day. During the later part of the flights the formation of a new cold spot was observed. It appears, however, that the upwelling in the center of the eddies is not the only source of the cool water but that advection of cool water and cooling by evaporation due to strong winds are also contributing factors. Author (TAB)

N70-39988# Teledyne Materials Research Co., Waltham, Mass.
WAVE HEIGHT MEASUREMENT TESTS Final Report
J. W. Wheaton 25 Aug. 1969 48 p refs
(Contract DOT-CG-94299-A)
(AD-708174; E-1184) Avail: NTIS CSCL 8/3

Tests were conducted to compare the sea spectra obtained by two different wave buoy configurations with sea spectra obtained simultaneously by the NAVOCEANO Wave Profiler, an airborne radar device. This report presents the results of the reduction of data from the two wave buoys. Analysis of the data indicates good agreement on the first day of tests, but significant differences on the second day. The effect of low-frequency cut-off is explored, and general conclusions are presented based on the tests. The data reported here are intended to be compared with the results obtained by the Canadian National Research Council and by the U. S. Naval Oceanographic Office. Author (TAB)

N70-40933# National Environmental Satellite Center, Washington, D.C.
AIRCRAFT MICROWAVE MEASUREMENTS OF THE ARCTIC ICE PACK

Alan E. Strong and Michael H. Fleming Aug. 1970 19 p refs
Presented at 51st Ann. Meeting of the Am. Geophys. Union, Washington, D.C., 20-24 Apr. 1970
(ESSA-TM-NESCTM-25) Avail: NTIS

Microwave radiometer data taken from an aircraft mission over the Arctic Ocean near Point Barrow, Alaska, are examined. The microwave brightness temperatures corresponding to varying ice pack conditions are correlated with simultaneous photography and infrared radiation data. Microwave measurements of the surface taken both through and from beneath a stratus cloudcover are investigated for atmospheric attenuation and emission effects. The influence of clouds is greatest when viewing surfaces such as

water, which appears cold at microwave frequencies because of its low emissivity. In general, cloudiness diminishes the capability of the 19.3-GHz radiometer to discriminate between ice and water. Polynya and other openings in the ice pack display a characteristic brightness temperature near 100 K when viewed through a cloud-free atmosphere, whereas they appear as much as 20 to 40 K warmer when clouds intervene between the surface and the radiometer. Author

N70-41551# Woods Hole Oceanographic Institution, Mass.
BOMEX METEOROLOGICAL DATA

Andrew F. Bunker Aug. 1970 30 p refs *Its Reference No. 70-34*
(Grant NSF GA-1700)
Avail: NTIS

CONTENTS:

1. TURBULENT FLUXES OBSERVED FROM THE WHOI AIRCRAFT, PART 1 A. F. Bunker p 1-15 refs

2. SOLAR RADIATION AVERAGES FROM WHOI AIRBORNE PYRANOMETER MEASUREMENTS, PART 2 A. F. Bunker p 19-29

N70-41552# Woods Hole Oceanographic Institution, Mass.
TURBULENT FLUXES OBSERVED FROM THE WHOI AIRCRAFT, PART 1

Andrew F. Bunker *In its BOMEX Meteorol. Data* Aug. 1970 p 1 15 refs
Avail: NTIS

The turbulence and turbulent flux observations made from the WHOI C-54 aircraft on ten days between 26 June and 28 July 1969 are reported. Root-mean-square values of the vertical and horizontal components of the turbulent velocity, the temperature and humidity fluctuations, and the turbulent fluxes of sensible heat, latent heat, momentum, and kinetic energy are tabulated together with supplementary position and weather information. Ninety seven individual one-minute runs were processed which were made at altitudes from 15 to 1400 meters. The method of obtaining the observations and computing the turbulence parameters are discussed. Averages of the values for several height ranges are formed for both undisturbed and disturbed conditions of the trade winds. The decrease in the average downward flux of sensible heat is produced by the presence of numerous upward fluxes in disturbed areas. The lower average latent heat flux for disturbed conditions is the result of numerous large negative fluxes in the 200 to 500 meter layer outweighing increased positive latent heat fluxes in the lowest 200 meters. The average shearing stresses in the lowest 400 m are 0.5 dynes/sq cm for undisturbed conditions and 0.8 dynes/sq cm for disturbed conditions. Author

N70-42184*# California Univ., San Diego. Visibility Lab.
ATMOSPHERIC LIMITATIONS ON REMOTE SENSING OF SEA SURFACE ROUGHNESS BY MEANS OF REFLECTED DAYLIGHT Final Report

S. Q. Duntley, C. F. Edgerton, and T. J. Petzold Sep. 1970 118 p refs
(Contract NAS12-2126)

(NASA-CR-73479; SIO-REF-70-27) Avail: NTIS CSCL 04A

A study of the limitations imposed by the earth's atmosphere on optical remote sensing of sea surface roughness from satellites and orbital spacecraft is presented. It is concerned with the optical and meteorological conditions at a single ocean location and in the near infrared region of the spectrum. There is a detailed description of the instrumentation used to make ground-based measurements of optical atmospheric data. The optical system, electronics, photocell circuit, and calibration procedures are defined. Author

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N70-42226# Naval Research Lab., Washington, D.C.
THE REMOTE SENSING OF OIL SLICKS BY RADAR
N. W. Guinard and C. G. Purves 1 Jun. 1970 35 p refs
(AD-709982) Avail: NTIS CSCL 13/2

The NRL Four Frequency Radar System, at Coast Guard request, was flown over the oil slick caused by the wreck of the tanker Arrow in the Chedabucto Bay area of Nova Scotia on 17 February 1970. The oil slick was mapped remotely from an EC-121 aircraft in both the horizontal and vertical polarizations. Synthetic aperture imagery was obtained in the P, X, L and C-band. This data clearly established the value of the radar sensing techniques as a tool for locating and monitoring oil spills.

Author (TAB)

N70-42628*# National Aeronautics and Space Administration.
Goddard Space Flight Center, Greenbelt, Md.
MEASUREMENTS OF MICROWAVE EMISSION FROM A FOAM COVERED, WIND DRIVEN SEA
W. Nordberg, J. Conaway, Duncan B. Ross, and T. Wilheit Oct. 1970 26 p refs Submitted for publication
(NASA-TM-X-65368; X-650-70-384) Avail: NTIS CSCL 04B

Measurements were made from aircraft of the 1.55 cm microwave emission from the North Sea and North Atlantic at surface wind speeds ranging from less than 5 to 25/msec. Brightness temperatures in the nadir direction increased almost linearly with wind speed from 7 msec to 25/msec at a rate of about 1.2 C per meter/sec. At 70 deg from nadir the rate was 1.8 C per meter/sec. This increase was directly proportional to the occurrence of white water on the sea surface. At wind speeds less than 7/msec, essentially no white water was observed and brightness temperatures in the nadir direction were about 120 K; at wind speeds of 25/msec white water cover was on the order of 30 percent and average brightness temperature at nadir were about 142 K. Maximum brightness temperatures for foam patches large enough to fill the entire radiometer beam were 220 K. Author

N70-43133*# Texas A&M Univ., College Station. Remote Sensing Center.
RADAR SCATTEROMETER DATA ANALYSIS: SEA STATE. NASA/MSC MISSION 20 AND MISSION 34
Richard W. Newton May 1970 22 p refs
(Grant NGL-44-001-001)
(NASA-CR-110865; RSC-09) Avail: NTIS CSCL 17B

An attempt to discover any characteristics which would distinguish the two sets of data from one another is reported. The missions were flown over different areas of the Atlantic Ocean involving two different types of sea, therefore, by extracting characteristic information from each set of data, the surface conditions could be inferred. The analysis was basically approached from an empirical sense and was only concerned with the information contained in the scatterometer data. The analysis was subjected to severe limitations due to an unavailability of all the data from the two missions and from a lack of sufficient ground truth. The analyses techniques did exhibit the fact that information relating to sea state was contained in the data, but further conclusions could not be drawn. D.L.G.

N70-43135*# Texas A&M Univ., College Station. Remote Sensing Center.
AN EXTENSION OF THE SLOPE-FACET MODEL OF RADAR BACKSCATTER FROM THE SEA
John W. Rouse, Jr. Sep. 1970 22 p refs
(Grant NGL-44-001-001)
(NASA-CR-110863; RSC-11) Avail: NTIS CSCL 17B

An extension of the slope-facet model is presented and consists of a unique approach to handling slope variations. In so doing an expression is developed for the normalized radar cross section which: (1) apparently applies for all angles removed from the vertical; (2) expresses the angular dependence as related to the wavelength dependence; (3) is a function of both the mean sea slope and the standard deviation of the slopes; and (4) provides a mechanism for calculating the upwind-downwind ratio as a function of slope statistics.

Author

N71-10364*# Washington Univ., Seattle. Dept. of Atmospheric Sciences.
PASSIVE MICROWAVE OBSERVATIONS OVER THE OCEANS
Lee Umphress Martin (M.S. Thesis) Aug. 1970 99 p refs
(Grant NGR-48-002-009)
(NASA-CR-111105) Avail: NTIS CSCL 08C

The predicted brightness temperatures that would be observed using several theoretical models of the ocean surface and atmosphere is investigated. Using the models, the predicted brightness temperatures are used to provide information about the following parameters: height of sensor, atmospheric effects, angular dependence of signal, surface roughness, surface films or slicks, foam and whitecaps. Real atmospheric profiles of temperature and relative humidity are used to calculate brightness temperatures for comparison to observed microwave observations over the oceans taken with a scanning radiometer at 19.35 GHz. Actual data used are from flights over the Pacific Ocean, the Gulf of Mexico and the Salton Sea. Conclusions are reached about the current theories of atmospheric and surface parameters and recommendations are made regarding possible modifications to the current roughness models of the ocean surface.

Author

N71-11151*# National Aeronautics and Space Administration
Manned Spacecraft Center, Houston, Tex.
SECOND ANNUAL EARTH RESOURCES AIRCRAFT PROGRAM STATUS REVIEW. VOLUME 3: HYDROLOGY AND OCEANOGRAPHY
1969 372 p refs Conf. held at Houston, Tex., 16-18 Sep. 1969
(NASA-TM-X-66481) Avail: NTIS CSCL 08H

Conference papers are presented on hydrological and oceanographic studies, and the use of aerial and spaceborne photography, infrared imagery, radar detection, and remote sensing in the studies.

N71-11156*# Geological Survey, Washington, D.C.
REMOTE SENSING OF OFFSHORE SPRINGS AND SPRING DISCHARGE ALONG THE GULF COAST OF CENTRAL FLORIDA
J. D. Hunn and R. N. Cherry 1. NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol 3 1969 7 p refs
Avail: NITS CSCL 08H

Color photography can be used to detect possible offshore springs submerged in shallow water. Identification of the possible springs and sinkholes on the photographs becomes increasingly difficult as their size on the image decreases. The temperature contrasts, as indicated by the 8-14 micron imagery and observed spring discharge, occurred where predicted by the project hypothesis. The imagery showed the contrasting temperatures of sea and aquifer-water and confirmed the existence of fresh-water discharge. The most easily interpreted results were obtained immediately before dawn when ground-water temperatures were

warmier than the Gulf of Mexico. When ground-water temperatures are colder than the Gulf, nighttime or early morning thermal contrasts related to offshore spring discharge could be mistaken for areas of the Gulf bottom exposed at low tide. Author

N71-11165*# Kansas Univ., Lawrence.

RADAR AND OCEANOGRAPHY

Richard K. Moore and Gerald Bradley /In NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 3 1969 30 p refs
 Avail: NTIS CSCL08J

The discussion of sea-state measurements is in three parts: (1) description of the results from Missions 70 and 88 of the NASA Earth Resources Aircraft Program; (2) description of the scatterometer system used in that program at 13.3 GHz; and discussion of the problems in validating the data obtained with this scatterometer. Studies of a technique for constructing spacecraft scatterometers using radiometer-like receivers show that this technique can yield precision measurements with less power than would otherwise be required for the transmitter; a microwave radiometer can indeed be used to calibrate the atmospheric attenuation for the scatterometer. Analysis of the tracking errors for a split-gate radar altimeter show that such a system can theoretically have accuracies of the order of a few tens of centimeters or better. Work studies indicate that the primary cause of radar return from the sea at angles away from the vertical is very fine structure whose height is of the order of the radar wave length.

Author

N71-11166*# California Univ., San Diego. Scripps Inst. of Oceanography.

SEA-SURFACE TEMPERATURE AND HEAT FLOW: BOMEX

E. D. McAlister /In NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 3 1969 16 p

Avail: NTIS CSCL08J

A two-wavelength infrared radiometer system for airborne measurement of the total energy exchange at the sea surface was tested at sea. These tests involved the first use of an airborne digital data reduction system for the output of this radiometer. Data were recorded on tape for repeated 30 second flights. In spite of severe weather conditions, tests on several days showed values of heat flow from 0.50 cal at 18 knots wind speed to 0.05 cal during intermittent rain squalls. These values result from simultaneous readings of radiation at two wavelengths from the sea, sky, the two reference blackbodies and their temperatures. Thirty thousand such readings are recorded in the 30 second fly-by and all are used to obtain the heat flow values. This is the first time that airborne total heat flow measurements have been made. The accuracy of sea-surface temperature measurements made with this system approaches 0.01 C.

Author

N71-11167*# TRW Systems Group, Redondo Beach, Calif.

EXPERIMENTAL RESULTS OF THE REMOTE MEASUREMENT OF OCEAN COLOR

Peter G. White /In NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 3 1969 10 p refs

Avail: NTIS CSCL08J

The data described were taken with one instrument from a number of locations—they include measurements of the spectral characteristics of water taken in the Pacific and Atlantic oceans

and in Crater Lake in Oregon. In all cases the measurements were made remotely from an aircraft flying at altitudes between 1000 and 10000 feet. Results indicate the following characteristics of water spectra: (1) high particle content increases reflectivity between approximately 0.5 and 0.6 micron; (2) high particle contents near the surface decrease reflectivity between 0.4 and 0.5 micron and increase it between 0.6 and 0.7 micron. This effect is minimized if there is a layer of clear water above the particles; and (3) certain absorption bands can be recognized.

Author

N71-11169*# Michigan Univ., Ann Arbor.

DEPTH DETERMINATION BY MEASURING WAVE SURFACE EFFECTS

F. C. Polcyn /In NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 3 1969 24 p refs

Avail: NTIS CSCL08J

Wave refraction due to shoaling is under investigation as one method which may be used to determine depth of water by remote sensing techniques. The forward velocity of individual waves decreases appreciably when the wave passes over an area in which the water depth is less than one-half the wave wavelength. By photographing the wave surface and measuring the wavelength changes, an estimate of water depth is feasible. By using optical processing techniques to form the Fourier transform of the wave pattern, a method may be found to systematically search a number of aerial or space photographs to locate unknown shallow waters. So far, a number of space photographs and aerial photographs have been analyzed and measures of depth have been obtained whenever the wavelengths were sufficiently long to be affected by the shallow depths. Transforms have been obtained without scanning to prove first the feasibility of measuring wavelength change.

Author

N71-11562*# Arctic Inst. of North America, Washington, D.C.

PERMAFROST EROSION ALONG THE BEAUFORT SEA COAST

Robert I. Lewellen (Denver Univ.) Mar. 1970 34 p refs
 (Contract N00014-70-A-0219-0001)

(AD-711344) Avail: NTIS CSCL 8/12

The purpose of the report is to illustrate and focus attention on the permafrost erosion along the Beaufort Sea coast of Northern Alaska. The thermal erosion of permafrost along the coast results in shore line recessions as great as ten meters (33 feet) per year. The recession is caused by wave action and air temperatures thawing the frozen sediments. The two areas which are discussed in detail are Elson Lagoon and Flaxman Island. Elson Lagoon is located south of Point Barrow, Alaska. Flaxman Island is adjacent to the Prudhoe Bay oil development activity. The receding shore lines must be considered before a logical definition of this region is possible.

Author (TAB)

N71-13088*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE DEVELOPMENT OF UPWELLING ALONG THE SOMALI COAST AS DETECTED WITH THE NIMBUS 2 AND NIMBUS 3 SATELLITES

Karl-Heinz Szekiella Sep. 1970 56 p refs Submitted for publication

(NASA-TM-X-65387; X-651-70-419) Avail: NTIS CSCL08C

The ground truth of remote-sensed equivalent blackbody temperature T_{sub BB} for the Persian Gulf as determined from Nimbus 2 satellite data was investigated. The T_{sub BB} values recorded with the high resolution infrared radiometer in this region were 0.1 C cooler than the reported ship temperatures. The

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standard deviation from the difference between T sub BB values and ship measurements was 1.29, indicating that over cloud-free regions very good accuracy from orbiting sensors can be obtained. The T sub BB recordings along the Somali coast showed the development of upwelled water between May 23 and June 8, 1966. The T sub BB analysis from July 3, 4, and 6 disclosed a very complicated structure near the coast, which can be explained by cyclonic and anticyclonic gyres. The temperature structure was confirmed by conventional ship data. The coldest temperatures were found on July 16 at 10 N near the coast with temperatures below 15 C. A very strong thermal gradient appears during the upwelling period between the Gulf of Aden and the adjacent sea. This indicates that the gulf has a separate surface circulation. Author

N71-13090* Woods Hole Oceanographic Institution, Mass.
THE COLOR OF THE OCEAN Report of the Conference,
Aug. 1969

William I. Thompson, III, comp. (NASA, Flight Res. Center)
[1969] 135 p refs Conf. held at Woods Hole, Mass., 5-6 Aug.
1969; sponsored by NASA
(Contract NAS12-163)
(NASA-CR-111570) Avail: NTIS CSCL08J

Presentations at a conference concerning the use of spectrophotometry and photography as an aid in aerial and satellite reconnaissance of the ocean to locate distinct water masses and areas of high biological productivity are given. Topics considered include: (1) upwelling radiance of the ocean with special reference to color; (2) applications to physical oceanography and to biological problems including primary productivity, fisheries, pollution, currents, and bottom studies; (3) the physical basis of upward radiance, scattering and absorption in the sea; and (4) instrumentation, data reduction, and interpretation. D.L.G.

N71-13701* Advisory Group for Aerospace Research and Development, Paris (France).

ELECTROMAGNETICS OF THE SEA Conference Proceedings
Nov. 1970 543 p refs Mostly in ENGLISH; partly in FRENCH
Meeting of AGARD Electromagnetic Wave Propagation Panel
Specialists held in Paris, 22-25 Jun. 1970
(AGARD-CP-77-70) Avail: NTIS

Electromagnetic wave applications in air-sea environments are discussed. The importance of underwater electromagnetic wave propagation for communication and optical imaging purposes is emphasized.

N71-14436* Woods Hole Oceanographic Institution, Mass.

BIOLOGICAL OCEANOGRAPHY
Gifford C. Ewing / In NASA, Electron. Res. Center Future Fields
of Control Appl. Aug. 1970 p 121-133

Avail: NTIS CSCL08A

Biological oceanography and ocean food resource development using satellite observation techniques are discussed. Satellite instrumentation is summarized and properties data are given for water temperature, color, and motion. E.C.

N71-14827* Communications Research Centre, Ottawa (Ontario).
Dept. of Communications

A SURVEY OF SEA-ICE-THICKNESS MEASURING TECHNIQUES

A. W. Adey Dec. 1970 28 p refs
(CRC-1214) Avail: NTIS

The approaches that have been made to the problem of

measuring sea-ice thickness by indirect means, the most serious difficulties involved in making such measurements, and the major capabilities and limitations of the several techniques are discussed. It is concluded from this review that there has not been proven, so far, a technique that can provide quantitative sea-ice-thickness data for survey purposes. Four techniques that are currently being seriously considered as offering potential for development as Remote-sensing devices to provide quantitative sea-ice-thickness data based on sensing to depth in the ice are (1) the multi-frequency microwave (UHF) radiometer, (2) the elastic-wave, or seismic-acoustic devices, (3) the dynamic penetrometer, and (4) the devices based on radio-propagation effects and operating in the frequency range from VLF to low MHz. Author

N71-15438* Joint Publications Research Service, Washington, D.C.

AIRBORNE OCEAN AND SEA SURFACE TEMPERATURE MEASUREMENTS USING INFRARED RADIOMETERS

N. N. Verenchikov 22 Dec. 1970 11 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 235, 1970 p 146-154
(JPRS-52039) Avail: NTIS

The dynamic errors of infrared radiometers are investigated, assuming that a bolometer exhibiting a sufficiently high sensitivity, low inertia, and simplicity in operation is utilized as the radiation receiver. Design criteria that associate equipment parameters and statistical characteristics of the temperature field of the object are formulated. R.B.

N71-16176* New York Univ., N.Y. Dept. of Meteorology and Oceanography.

RADAR SEA RETURN AS A FUNCTION OF WAVE HEIGHT AND WIND SPEED FOR FULLY DEVELOPED SEAS

Willard J. Pierson, Jr. / In NASA, Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 3 1968 27 p refs
Avail: NTIS CSCL08C

The results of missions 20, 34, 60, and 70 are reanalyzed as a function of upwind, downwind, and crosswind conditions. Results are presented in both tabular and graphical form and in terms of mesoscale variability in the conditions at the sea surface, so that all possible sources of scatter are considered. The analysis is based on a total of 916 individual measurements of the radar scattering cross section versus the beam angle for three basically different, fully developed seas. Author

N71-16177* Naval Oceanographic Office, Washington, D.C.

SEA-STATE MEASUREMENTS WITH A RADAR PROFILOMETER

Lionel I. Moskowitz / In NASA, Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 3 1968 6 p refs

Avail: NTIS CSCL08C

Mission 70, conducted in Iceland in early April 1968, had as a prime objective the determination of high sea states by radar scatterometry. For the purpose of defining the characteristic scatterometer curves, a test site was chosen which would offer a very good probability for providing high sea states and a suitable airbase for the NASA Manned Spacecraft Center P-3 aircraft. In addition, ground truth in the form of meteorological and oceanographic information was obtained from permanent weather stations located southwest, southeast, and east of Iceland. The aircraft used for ground truth measurements provided data pertaining to ocean wave heights, sea surface temperature, and temperature as a function of water depth. Author

N71-16178* Texas A&M Univ., College Station.

RADAR SCATTEROMETER MEASUREMENTS OF SEA ICE

J. W. Rouse, Jr. *In* NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 3 1968 29 p refs

Avail: NTIS CSCL08C

The radar data were recorded by a 13.3-gigahertz radar scatterometer, continuous wave Doppler instrument which measures the scattering coefficient of individual resolution cells over the range of incidence angles from 60 deg ahead to 60 deg aft of the aircraft. The fact that the data are related to individual cells (approximately 100 feet square) along the flight path and that the ice type was known for each cell resulted in signatures of the ice types. These signatures, in the form of scattering-coefficient curves versus incidence-angle curves, are sufficiently unique that ice-type discrimination is possible. Detailed analysis of three flight lines over different regions of the arctic ice pack is given. Each line is documented with aerial photography and continuous narration by a Navy aerographic observer. The analysis includes comparison of radar return amplitude as a function of time with the air photomosaic of the flight line, comparison of scattering-coefficient curves for various ice types, and an estimation of the surface statistics obtained by fitting the data to the backscatter theory based on the Kirchhoff-Huygens principle. Author

N71-16180* Massachusetts Inst. of Tech., Cambridge. Experimental Astronomy Lab.

OCEAN BOTTOM SURVEYING WITH AERIAL PHOTOGRAPHY

A. C. Conrod and H. A. Short (Naval Oceanog. Office) *In* NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 3 1968 17 p

Avail: NTIS CSCL08J

The application of photography and spectrography to ocean surveying was investigated. Photographic tests show that good bottom detail may be obtained at depths ranging in some cases to more than 25 meters, and biological and geological features can be seen and interpreted. The method shows promise as a survey tool for examining the near-shore environment and in studying land-sea interactions, both natural and artificial. Spectrometric experiments show that the kinds and amounts of suspended and dissolved water may be estimated with airborne radiometers. The uses of photography versus electro-optical imaging systems for possible operational use on ERSP and EROS satellites are mentioned, and some of the design and application aspects of nonphotographic imaging systems are discussed. Author

N71-16182* Bureau of Commercial Fisheries, Pascagoula, Miss. **REMOTE SENSING OF FISHERY RESOURCES**

Kirby L. Drennan *In* NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 3 1968 2 p

Avail: NTIS CSCL06C

The feasibility of locating, identifying, and quantifying surface and near-surface fish stocks from aircraft and future spacecraft is considered. The spectral properties, thermal patterns, and other characteristics associated with pelagic fish schools and surface fish-oil films, which permit location and identification through the use of remote sensors, are investigated. The potential application of image intensifiers for locating fish schools during nighttime operations from the bioluminescence associated with most schools is also discussed. Author

N71-16183* California Univ., San Diego. Scripps Inst. of Oceanography.

AIR-SEA INTERACTIONS

E. D. McAlister *in* NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 3 1968 13 p

Avail: NTIS CSCL08C

An infrared two-wavelength radiometer was developed to measure the heat flow to the ocean surface by measurement of water temperature at two different depths. The fraction of total heat flow by different mechanisms is shown as a function of depth. Turbulence dominates at depths up to a few millimeters, below which conduction becomes the dominant mode of transport. R.B.

N71-16184* Texas A&M Univ., College Station. Dept. of Oceanography.

RESULTS OF REMOTE-SENSING TESTS FOR OCEANOGRAPHY AT TEXAS A AND M UNIVERSITY

Jack F. Paris *In* NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 3 1968 51 p refs

Avail: NTIS CSCL08C

Airborne tests of multispectral remote sensors were conducted over the Mississippi Delta area and eastern Gulf of Mexico to determine the usefulness of the sensors in surveying river, coastal, and deep-sea phenomena. Four of these tests were supported concurrently by oceanographic research vessels. Passive remote sensors, principally metric microwave radiometers, were flown at 1500, 5000, 10,000, and between low cloud development and horizontal anomalies in the sea surface temperature field and studies into basic microwave research were conducted. The following features of the Mississippi River were surveyable by remote sensors from aircraft: (1) location of surface frontal zones of convergence, (2) determination of surface water mass type, (3) small-scale pattern of mixing, (4) location of internal waves, and (5) general outflow pattern shape and extent. Author

N71-16663* Michigan Univ., Ann Arbor. Inst. of Science and Technology.

THE MEASUREMENT OF WATER DEPTH BY REMOTE SENSING TECHNIQUES

F. C. Polcyn, W. L. Brown, and I. J. Sattinger Oct. 1970 48 p refs

(Contract N62306-67-C-0243)

(AD-714001; Rept-8973-26-F) Avail: NTIS CSCL8/10

The study demonstrates successful remote determination of shallow water depth by measuring wave refraction changes and using the Fourier transform plane for wavelength measurements with data obtained at a Lake Michigan test site. The study shows that the technique is suitable for use from spacecraft altitudes, provided that water waves of suitable length occur in the region of interest. Author (TAB)

N71-16920* Joint Publications Research Service, Washington, D.C.

OCEANOGRAPHY

In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 244 15 Jan. 1971 p 19-28 refs

Avail: NTIS

News briefs and abstracts of scientific articles are presented on Soviet research ships, infrared aerial survey for studying ice cover, stereophotogrammetric unit for underwater photography, the onset of convection in a fluid near the density inversion temperature, rationalization of hydrological observations in the North Sea, mesostructure of geostrophic currents in the open ocean, orientation of rift valleys in mid-oceanic ridges, continuous seismic profiling in the ocean, stepped structure of temperature inversions in the ocean, variability of position of the Gulf Stream front, diurnal oxygen regime in tropical Atlantic waters, components of external heat balance of the oceans, variability of wind and thermohaline currents

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in the North Atlantic, and structure of wind velocity field over the ocean. R.B.

N71-17801# Delaware Univ., Newark.
RESEARCH IN THE COASTAL AND OCEANOGRAPHIC ENVIRONMENT Annual Status Report, 1 Sep. 1969-31 Aug. 1970

William S. Gaither Oct. 1970 37 p refs
(Contract N00014-69-A-0470; Proj. Themis)
(AD-714853; CMS-3MD028) Avail: NTIS CSCL 8/3

Progress during the first year of a multidisciplinary study of the coastal environment of a section of the Atlantic Sea Coast (Delaware and adjacent New Jersey and Maryland areas) is summarized. Included are field, laboratory, and theoretical investigations of sedimentary processes, coastal vegetation, tidal marsh soils, wave action and attenuation, air-sea interactions, geological history and marine biology. Correlation of ground observations with high altitude photographic imagery to provide a useful method for the remote characterization of such coastal regions is an important objective. Author (GRA)

N71-18334# New York Univ., N.Y. Dept. of Biology.
AERIAL PHOTOGRAPHIC STUDIES OF THE COASTAL WATERS OF NEW YORK AND LONG ISLAND
Mahlon G. Kelly and Louis Castiglione 12 Nov. 1970 76 p refs Original contains color illustrations
(Contract N62306-70-A-0073-0003)
(AD-715804) Avail: NTIS CSCL 8/1

Contents: Aerial photography; (Data acquisition, Comparison of color photography, Exposure, Multispectral photography, Depth penetration, Altitude differences); Photoenhancement; (Video enhancement, Photographic enhancement process, Imaging microdensitometry, Color separation); Field studies of water characteristics; Photointerpretation of benthic materials. GRA

N71-18409*# National Aeronautics and Space Administration.
Goddard Space Flight Center, Greenbelt, Md.
OCEANOGRAPHIC APPLICATIONS OF COLOR-ENHANCED SATELLITE IMAGERIES
K.-H. Szekielda and W. F. Mitchell Jan. 1971 17 p refs
Submitted for publication
(NASA-TM-X-65454; X-651-71-53) Avail: NTIS CSCL 14E

Black and white infrared imageries obtained from satellites over the oceans were transformed into color presentations. Investigations in different regions (Persian Gulf, Arabian Coast, Somali Coast and the Northwest Coast of Australia) reveal that temperature gradients and temperature differences of two degrees Celsius can be displayed by the color process from the imageries. This data display can be used for a rapid analysis of information obtained with an APT station. Author

N71-18888# Aerojet-General Corp., El Monte, Calif. Microwave Div.
PASSIVE MICROWAVE MEASUREMENTS OF OCEANOGRAPHIC PHENOMENA, ICE, AND SEDIMENTS
Technical Report, 16 Nov. 1968-15 Feb. 1970
A. T. Edgerton, D. T. Trexler, G. A. Poe, A. S. Stogryn, and S. Akamoto Nov. 1970 116 p refs
(Contract Nonr-467(00))
(AD-715845; AGC-9016-R-7) Avail: NTIS CSCL 8/3

Airborne measurements were conducted off the Northern California coast to investigate microwave emission as a function of wave conditions. The measurements were performed at observational wavelengths of 21 and 0.81 cm. A series of rosette patterns centered near the San Francisco Light Ship were flown

to acquire data parallel and perpendicular to the swell line. Sea surface and meteorological conditions were monitored by the light ship. The data have been analyzed in terms of changes in the average brightness temperature due to variations in the surface roughness and direction of propagation of the swell line relative to the aircraft flight path. Power spectral density analyses have been performed to determine if periodic variations in the microwave emission can be related to the period of the predominant wave structure. Measurements were taken at various altitudes and of a variety of sea states. Author (GRA)

N71-20422*# Texas A&M Univ., College Station. Dept. of Oceanography.

OCEANOGRAPHIC EXPERIMENT SUPPORT: REMOTE SENSING OF COASTAL OCEANS Annual Report, May 1969-May 1970

10 May 1970 143 p refs
(NASA Order W-12879; Contract N62306-69-C-0263)
(NASA-CR-117316) Avail: NTIS CSCL 08C

The status of microwave radiometry uses in making meaningful oceanographic observations is summarized. Plans for international cooperative oceanographic expeditions are cited including measurement of biomass production and associated phenomena in the marine environment. An analysis of data recorded on ships and NASA aircraft missions around Veracruz, Mexico is presented. Color, false color infrared, and multiband photography in four spectral bands and infrared imagery from aircraft flights over Cabo Frio, Brazil are analyzed. Oceanographic features observed in Apollo 9 photographs are outlined as well as upwelling detection from space photography. J.M.

N71-21938# Rosenstiel School of Marine and Atmospheric Sciences, Miami, Fla.
MONSOONAL RESPONSE IN THE WESTERN INDIAN OCEAN

Walter Dueing and Karl-Heinz Szekielda Jan. 1971 21 p refs
(Contract N00014-67-A-0201-0013)
(AD-717391; ML-71004) Avail: NTIS CSCL 8/3

Infrared observations from spacecraft are used to investigate the response of the Somali Current to the onset of the Southwest Monsoon. Selected satellite observations from three years were available for this study (Nimbus series 1966, 1969, and 1970). The time-dependent development of horizontal temperature gradients at the sea surface serves as an indicator for the formation of the baroclinic structure of the Somali Current. A comparison is made with the simultaneous development of the southwest component of the monsoon wind. The investigation reveals that the temperature gradients during the early formation stage in all years are directly proportional to the wind speed. The phase lag between the development of wind and temperature gradient is surprisingly short during the buildup of the boundary current, ranging between three and ten days. During the decay period in late summer and fall, the temperature gradients lag 14 to 40 days behind the wind. The observations suggest that two phenomena of different spatial scales play an important role during the formation of the Somali Current. Author (GRA)

N71-22685# Joint Publications Research Service, Washington, D.C.

OCEANOGRAPHY
In its Soviet Bloc Res. in Geophys., Astronomy, and Space. No. 248 16 Mar. 1971 p 11-19

Avail: NTIS

Ocean floor structure, seismic sounding at sea, and other oceanographic studies are briefly reported. Seismic studies were made of the shelf off Sakhalin and the Mediterranean floor, and developments in seismic prospecting are reviewed. Air photographs

of the Sakhalin shelf, acousting sounding of the Indian Ocean floor, coastal marine deposits, geosynclinal processes in the ocean, air flow structure over water, and marine gravimeters are described:
N.E.N.

N71-23326# Texas A&M Univ., College Station. Dept. of Oceanography.

OCEANOGRAPHIC EXPERIMENT SUPPORT: REMOTE SENSING OF COASTAL OCEANS Annual Report, May 1969-May 1970

Luis R. A. Capurro 10 May 1970 143 p refs

(Contract N62306-69-C-0263)

(AD-717936; A/M-Ref-70-20A) Avail: NTIS CSCL 8/10

Contents: The present status of the uses of microwave radiometry in making meaningful oceanographic observations; International program - general; International program - Mexico; International program - Brazil; Analysis of Apollo 9 photography; and Upwelling detection from space photography. GRA

N71-23593# Naval Oceanographic Office, Washington, D.C.

MICROWAVE OBSERVATIONS OF THE OCEAN SURFACE. ANALYSES OF THE NASA/NAVY REVIEW SPACECRAFT OCEANOGRAPHY PROJECT

Dec. 1970 293 p refs Conf. held at Washington, D.C., 11-12 Jun. 1969

(AD-718773; NOO-SP-152) Avail: NTIS CSCL 8/3

For quite sometime oceanographers and meteorologists have been attempting to describe dynamic ocean features as a function of various meteorological parameters. Data used in past studies have been limited by location, instrumentation, and processing. Only recently have remote sensing techniques been applied to determining dynamic ocean features. The results of recent passive and active microwave experiments are presented in the papers contained in this report. Passive microwave (radiometric) observations appear to show that this technique may be capable of determining surface roughness conditions (sea state, spray, percentage of foam and whitecaps, etc.). Active microwave (radar) results appear to show a non-linear relationship of the backscatter cross section as a function of windspeed. Radar data is also being used to describe more fully the high frequency component of the ocean wave spectrum. Author (GRA)

N71-25888# Computer Sciences Corp., Falls Church, Va.

SPACECRAFT OCEANOGRAPHY: PROJECT DOCUMENTATION STUDY Final Report

William L. Vest and B. D. Claggett Nov. 1970 324 p refs

(NASA Order W-12879; Contract N62306-70-C-0149)

(NASA-CR-118644) Avail: NTIS HC\$6.00/MF\$0.95 CSCL 08J

Results of the study on the acquisition of oceanographic information by spaceborne instruments and the utilization of the data are presented. The users, both real and potential, are identified, and their information requirements are documented. Progress made towards sensing the phenomena and utilizing the data, and the overall status of remote sensing of oceanographic parameters are discussed. The information management systems and the potential benefits are described. Author

N71-26904# Joint Publications Research Service, Washington, D.C.

OCEANOGRAPHY

In its Soviet Bloc Res. in Geophys., Astronomy, and Space, No. 252 14 May 1971 p 8-10 refs

Avail: NTIS

A method for determining ocean current direction and velocity

on the basis of an investigation of the temporal and spatial variability of surface temperature is described. The initial data used are synchronous maps which are now obtained using infrared thermometers carried aboard an aircraft or on an artificial earth satellite. The proposed method is somewhat similar to the method for studying currents by use of floats. In this case the role of floats is played by temperature inhomogeneities. The basis of the method is a study of the dynamics of temperature inhomogeneities. It must be taken into account that with time these temperature inhomogeneities are blurred due to turbulent diffusion and other factors. The estimate of the lifetime of an inhomogeneity influences the choice of scales of the studied phenomena in time and space. The method for determining current velocity is described in detail. The relative simplicity of obtaining the necessary initial data makes it possible to construct a map of currents over extensive areas and to study their temporal variability. Author

N71-27497 World Meteorological Organization, Geneva (Switzerland).

SOME DYNAMICAL FEATURES OF THE INDIAN SUMMER MONSOON AS DEDUCED FROM NIMBUS 2 SATELLITE RADIATION DATA

K. R. Saha, D. R. Sikka, and P. Krishna Rao *In its Radiation Including Satellite Tech.* 1970 p 79-83 refs

Copyright. Avail: Issuing Activity

An analysis is presented of Nimbus 2 radiation data applied to the distribution of cloud systems over the Indian Ocean area over a period of three consecutive days when the summer monsoon was in the process of advancing over India. The dynamic origin of the cloud system as revealed by radiation data is discussed. ESR0

N71-27648# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

AIR-SEA INTERACTION IN THE TROPICAL PACIFIC OCEAN

Lewis J. Allison, Joseph Steranka, Robert J. Holub (AF), John Hansen (AF), Fredica A. Godshall (NOAA) et al May 1971 108 p refs Submitted for publication

(NASA-TM-X-65558; X-651-71-191) Avail: NTIS CSCL 08C

An atlas of 3 monthly sea surface temperature anomalies in the eastern tropical Pacific Ocean was produced for the period 1949 to 1970. Sea surface temperature anomalies along the U.S. and South American west coasts and eastern tropical Pacific, appeared to be oscillating in phase from 1949 to 1970. Similarly, the satellite derived cloudiness for each of four quadrants of the Pacific Ocean, 130 E-100 W, 30 N-25 S were also pulsating in unison. The sea surface temperature anomalies were found to have a good degree of correlation both positive and negative with the monthly geophysical parameters. Several strong direct local and cross equatorial relationships were noted. In particular, the high degree of correlation between the tropical island rainfall and sea surface temperature anomalies ($r = +0.93$), permitted the derivation of sea surface temperatures in the tropics back to 1905. The air-sea interactions indicated in this study could be potentially valuable in the prediction of the seasonal behavior of the tropical Pacific ocean and the atmosphere above it. Author

N71-28328# Ocean Data Systems, Inc., Rockville, Md.

ADVANCED STUDY OF COASTAL ZONE OCEANOGRAPHIC REQUIREMENTS FOR ERTS E AND F

D. A. Adams, J. Fry, H. Gurk, J. Hudgens, R. Newell et al 18 Feb. 1970 162 p refs

(Contract NAS1-10281)

(NASA-CR-111823) Avail: NTIS CSCL 08J

The important coastal zone issues and marine-related data

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needed to aid in resolving them are identified. The data which might be acquired by satellite and the appropriate orbital and sensor characteristics for coastal missions are outlined. Recognizing the importance of high resolution and high frequency of coverage for these missions, the proposed spacecraft characteristics are: orbital inclination 72 degrees optimized for the coastal zone at an altitude of about 700 km with a high resolution multispectral imager, an IR imager, a low resolution multispectral imager, and visible near-IR spectrometer. Sensors should be pointable so that most coastal areas can be observed possibly on three out of four days. Author

N71-28810# Philco-Ford Corp., Palo Alto, Calif. Space and Re-entry Systems Div.

OCEANOGRAPHIC IMAGE ENHANCEMENT Final Report, Mar. 1969 - Jan. 1970

Donald S. Ross 15 Jan. 1970 48 p ref

(Contract N62306-69-V-0072)

(AD-722482; SRS-TR-DA2164) Avail: NTIS CSCL 14/5

Eleven images of ocean subjects selected from Gemini and Apollo 70 mm color photography were enhanced by Photo-optical means, producing false-color contours of small changes in density and color. Bathymetry, sediment concentrations and flow patterns are delineated by the process, interpretation and information yield improved. Correlation with charted depth contours was found, in one instance to 20 fathoms, although none of the photography was optimum for water penetration. The utility of space photography and enhancement processes for determining relative water depths and updating charts is apparent from this and previous work. The results of spectral filter tests for water penetration conducted under the same contract and reported in detail earlier are summarized.

Author (GRA)

N71-31080 Wisconsin Univ., Madison.

A SATELLITE STUDY OF LARGE STATIONARY POLYNIES IN ANTARCTIC COASTAL WATER

Warren Willard Knapp (Ph.D. Thesis) 1969 130 p

Avail: Univ. Microfilms Order No. 70-3587

Nimbus satellite observations have been used to investigate large stationary polynyas, ice free areas in the midst of ice covered waters, during the winter season in the coastal waters of Antarctica. The results of the investigation show that large stationary polynyas are numerous and widely distributed in Antarctic coastal waters. It is concluded that the origin of these large polynyas is due to wind action removing the annual sea ice cover in the vicinity of fast ice or continental boundaries. Available evidence suggests that the size and position of the open water areas, with respect to the fast ice or other fixed boundaries at any given time, depends primarily on the intensity of the surface pressure gradient, the speed and direction translation, and the location of the center track of the prevailing synoptic system relative to the polynya site.

Dissert. Abstr.

N71-31374# Naval Oceanographic Office, Washington, D.C.

SOME STATISTICAL CHARACTERISTICS OF COASTAL CURRENTS BASED ON AERIAL PHOTOGRAPHS [NEKOTORYE STATISTICHESKIE KHARAKTERISTIKI PRIBREZHNYKH TECHENII PO REZULTATAM AEROFOTOSEMKI]

I. Z. Konovalova et al 1971 20 p refs Transl. into ENGLISH from Tr. Gos. Okeanogr. Inst. (Moscow), v. 95, 1968 p 72-84 (AD-722839; NOOTrans-486) Avail: NTIS CSCL 8/3

Special observations using aerial photographs off the Caucasian coast of the Black Sea and in the Gulf of Riga of the Baltic Sea indicate that coastal currents in these areas have certain similarities. Their speeds and directions are related mainly to distance from the coast and not so much to geographic location or other

circumstances. The observations made in conjunction with theoretical formulae characterizing coastal currents indicate that the mean velocity of surface coastal current increases with distance from the coastline. At a distance of 20-25km, the value is four times greater than at a distance of 0-1 km. It was further indicated that the increase of mean velocities is rapid at the beginning, but that starting with 4.5-6.5km from the coastline, the rate of increase slows down rapidly, being 6cm/sec at a distance of 10km. Because the conclusions are based on a limited amount of data, they can be considered preliminary steps in the study of coastal currents with the aid of aerial photographs. Author (GRA)

N71-31790# Deutscher Wetterdienst, Offenbach am-Main (West Germany).

AIRBORNE SURFACE TEMPERATURE MEASUREMENTS OF THE SEA [FLUGZEUGMESSUNGEN DER OBERFLAECHENTemperatur ueber See]

Dieter Lorenz Bonn Bundeswehramt Sep. 1970 41 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. der Verteidigung

(BMVg-FBWT-71-7) Avail: NTIS; Bundeswehramt, Bonn; 26 DM

Three series of airborne surface temperature measurements over the North Sea, mainly in the Bay of Helgoland, using infrared radiation thermometers are described. The resulting isotherm maps are discussed. Local changes and discontinuities of the water surface temperature are accounted for. In one case a change of 1.6 C was recorded within a short distance on deep sea. ESRO

N71-32148*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

UPWELLING STUDIES WITH SATELLITES

Karl-Heinz Szekielea Jul. 1971 20 p refs Submitted for publication

(NASA-TM-X-85643; X-651-71-298) Avail: NTIS CSCL 08C

Recent investigations with satellites over upwelling areas are presented. Using different techniques (as color enhancement and multispectral methods) the dynamics of upwelling water in connection with the Somali Current, the Canary Current, the Benguela, and the Agulhas Current were analyzed. Studies in the Somali Current revealed a very fast response time of the cold water onto the onset of the Southwest Monsoon. Separated cold patches were detected in the Somali upwelling area and along the Northwest Coast of Africa. They are probably produced by varying wind action. The radiation temperatures along the southwest and southeast coast of Africa showed the appearance of upwelling in connection with the Agulhas Current and the Benguela Current. Both areas are separated by the warm water from the Agulhas Current which leaves the coast in southwest direction at about 34 S.

Author

N71-32578*# Michigan Univ., Ann Arbor.

ATMOSPHERIC EFFECTS ON INFRARED MULTISPECTRAL SENSING OF SEA-SURFACE TEMPERATURE FROM SPACE

D. Anding, R. Kauth, and R. Turner Washington NASA Jul. 1971 103 p refs

(Contract NAS12-2117)

(NASA-CR-1858) Avail: NTIS CSCL 04B

The effect of the atmosphere on the infrared spectral radiance emanating from the sea surface is defined. The application of multichannel infrared remote sensing as a means of compensating for these atmospheric effects to obtain improved estimates of the sea temperature from high-altitude or space platforms is also discussed. It is demonstrated that by performing simultaneous radiometric measurements in three narrow spectral intervals centered at 4.9, 9.1, and 11.0 microns, the effects of noncloudy atmospheres on the observed radiance can be nearly completely

compensated for and estimates of sea temperature to an accuracy of 0.15 K can be obtained. For fields of view which contain clouds, the three-channel radiometric data also provide the necessary information to indicate the presence of semitransparent or opaque clouds within the field of view and, if opaque, the fractional amount of cloud obscuration to an accuracy of approximately 10% for any field-of-view size. Author

N71-32636# Oregon State Univ., Corvallis. Dept. of Civil Engineering.

AERIAL PHOTOGRAPHIC TRACING OF PULP MILL EFFLUENT IN MARINE WATERS

Fred J. Burgess and Wesley P. James Aug. 1970 160 p refs (Grant FWQA-WP-00524)

(PB-198232; W71-06258) Avail: SOD\$1.25; NTIS CSCL 13B

Aerial photography taken of waste plumes from Kraft pulp mill ocean outfalls was shown to be an effective tool in the study of waste disposal sites. This technique is not limited by sea conditions and permits monitoring and evaluation of outfall sites throughout the year. Photography taken at one instant provides comprehensive information throughout the waste field. Manpower requirements and costs for this method are considerably less than for conventional boat sampling surveys. Field studies were conducted on the waste plumes from Kraft pulp mill ocean outfalls at Newport and Gardiner, Oregon and Samoa, California. Waste concentrations were measured by conventional boat sampling techniques while aerial photography was taken of the outfall area from altitudes ranging from 3,000 to 11,000 ft. Computerized procedures were used to compute water currents, waste concentrations, toxicity zones and diffusion coefficients from the photography. The maximum concentration determined over the outfall for each field study was generally less than that shown to have a detrimental effect on young salmon for a 14-day exposure. Surface water current was to be the dominant factor in the resulting plume pattern. During periods of low current velocities in the receiving water, the hydraulic head created by the effluent source was a significant factor in the resulting plume shape. Author

N71-32961# Naval Oceanographic Office, Washington, D.C.
PHOTOGRAMMETRY IN MARINE INVESTIGATIONS OF HYDROTECHNICAL PROJECTS. CHAPTER 4: STEREOPHOTOGRAPHY OF ICE

D. I. Nikoforov 1971 11 p Transl. into ENGLISH from the Monograph "Fotogrammetriya V Morskikh Issledovaniyakh Pod Gidrotekhnicheskimi Sooruzheniyami" Leningrad, 1957 p 73-78 (AD-724464; NOO-TRANS-113) Avail: NTIS CSCL 8/12

Stereophotography of ice is analyzed so as to present the significance of photographic records in determining the type of ice, its mass and displacement in areas where hydrotechnical structures are to be built. Author (GRA)

N71-33197# Naval Oceanographic Office, Washington, D.C.
CHANGES IN THE POSITION OF ICE EDGE IN NORTH CASPIAN AND THE PROSPECTS OF THEIR FORECASTING [OB IZMENCHIVOSTI POLOZHENIYA KROMKI LDA V SEVERNOM KASPII VOZMOZHNOСТИ EE PREDSKAZANIYA]
E. S. Karakash 1971 33 p refs Transl. into ENGLISH from Tr. Gos. Okeanogr. Inst. (Moscow), v. 76, 1964 p 80-103 (AD-724672; NOO-TRANS-523) Avail: NTIS CSCL 8/12

Yearly, monthly and ten-day changes in the position of ice edge in the North Caspian are discussed in detail, giving data on the width of shore ice and drift ice belts. The ice edge is related to the intensity of atmospheric circulation, air temperature, iciness and synoptic processes prior to forecasting. Equations used in forecasting the position of ice edge have large correlation coefficients

(more than 80). The reliability of forecasting based on equations exceeds the natural reliability and is slightly smaller than the inertial reliability, no matter what the calculation errors are. The data on iciness in the North Caspian are reduced to the 15th day of each month from 1928 to 1962. In addition, coordinates of ice edge are given for the period. Author (GRA)

N71-34347# Naval Civil Engineering Lab., Port Hueneme, Calif.
OCEAN ENGINEERING SIGNIFICANCE OF MARINE SEISMIC REFLECTION PROFILING TECHNOLOGY Final Report, Jul. 1969 - May 1970

E. F. Pawlowicz May 1971 52 p refs

(AD-724674; NCEL-TN-1157) Avail: NTIS CSCL 08/10

Seismic reflection profiling SRP data of value to the seafloor engineer include: (1) sediment soil thickness; (2) sediment structure; (3) the slope of the bedrock beneath the sediment layer; (4) bedrock topography, is sufficient tracklines are run to permit contouring; (5) bedrock structure, if penetration permits; and (6) acoustical data from which certain physical, engineering, and load bearing properties of an area can be approximated. Qualitative interpretations of acoustical data are made as a matter of course by the experienced analyzer of SRP records and include such parameters as: echo intensity from the seafloor and subbottom interfaces, indicating hard high reflectivity and soft low reflectivity layers; penetrability of the seafloor (in unconsolidated sediments) is generally inversely proportional to grain size; point return, or discrete hyperbolic echo returns, indicative of large irregularities compared to the sound frequency recorded, such as boulder beds, or a weathered bedrock surface. Author (GRA)

N71-35453# National Oceanic and Atmospheric Administration, Miami, Fla. Environmental Research Labs.

THE NOAA RESEARCH FLIGHT FACILITY'S AIRBORNE DATA COLLECTION PROGRAM IN SUPPORT OF THE BARBADOS OCEANOGRAPHIC AND METEOROLOGICAL EXPERIMENT

Howard A. Friedman, John D. Michie, and James D. McFadden Oct. 1970 185 p refs

(NOAA-TR-ERL-198-ERL-4) Avail: SOD \$1.50

The three Research Flight Facility (RFF) aircraft, supporting the overall program of BOMEX, flew 146 missions for approximately 1138 hours. During these flights, almost three million digitally recorded meteorological observations, numerous sea-surface temperature and water vapor flux measurements, over two million cloud and radar photographs, and other special data were obtained for subsequent analysis and research application. The scientific objectives of the program, the RFF aircraft capabilities, and the instrumentation systems that supported BOMEX are briefly described. An inventory of the BOMEX field experiment data collected by the RFF from May through July 1969 is given. Author

N71-36973# Atlantic Oceanographic and Meteorological Labs., Miami, Fla.

COLLECTED REPRINTS, 1969, VOLUME 2

Sep. 1970 546 p refs Prepared in cooperation with Pacific Oceanog. Lab.

Summary data are presented on the results of scientific and technical work on experimental meteorology and physical oceanography.

N71-36999# Environmental Science Services Administration, Washington, D.C.

THE POTENTIAL APPLICATION OF REMOTE SENSING TO SELECTED OCEAN CIRCULATION PROBLEMS

Raymond M. Nelson /in Atlantic Oceanog. and Meteorol. Labs. Collected Reprints, 1969, vol. 2 Sep. 1970 8 p refs Repr. from Oceans from Space, p 38-45

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Avail: SOD \$3.75

In addition to aerial photography and airborne infrared radiation devices, remote sensing is being explored for its potential application to selected ocean circulation problems.

E.M.C.

N71-37476# Naval Research Lab., Washington, D.C.
[OCEAN SURFACE SENSING, ATMOSPHERIC TRANSMISSION, AND SCIENTIFIC PROGRAM NOTES] Report of NRL Progress, Aug. 1971

Aug. 1971 43 p refs

Avail: NTIS

Remote sensing of ocean surface conditions by radar is studied by theoretical radar sea return models as well as by experimental determinations of some of the parameters of the radar return which can be related to ocean parameters. Radar detection of oil films on ocean surfaces and the sensing of surface winds by Doppler spectra are emphasized. Studies on the transmission of infrared radiation through the earth's atmosphere near 5 microns detail spectral regions of carbon monoxide and iodine laser transitions. Also included are brief reports on projects pertaining to: sea photo diffraction analysis; design of uniform random number generator; radiation effects on thick steel; radiation damage to pressure vessel surfaces; X-ray diffraction analyses on plastic deformations of metallic microstructures; thickness effects on fracture resistance of titanium alloy sheets; fracture toughness of aluminum alloy sheet; fracture safe design with titanium alloys; corrosion mechanisms in metals; development of neutron spectrometer with organic scintillators; elastic stiffness of single crystal lead; sea water effects on photographic film; optical waveguides and integrated optics technology; laser beam propagation through the atmosphere; target tracking algorithms for search radar; glass contamination by platinum; and the design of a digital autotracking antenna system.

N71-37477# Naval Research Lab., Washington, D.C. Wave Propagation Branch.

REMOTE SENSING OF OCEAN EFFECTS WITH RADAR

c13

N. W. Guinard *In its Ocean Surface Sensing, Atmospheric Transmission, and Sci. Program notes* Aug. 1971 p 1-11 refs Presented at the AGARD Conf. on Propagation Limitations in Remote Sensing, Colorado Springs, 22 Jun. 1971

Avail: NTIS

Radar techniques and trends available in ocean studies for the collection of data pertaining to research in the field of remote sensing are discussed. A review of theoretical models and their parametric relationships which offer promise in the design of sensors is presented. Two new techniques for remotely sensing wave spectra are developed and used to obtain an explanation for the wavelength dependence of the sea return in low wind fields. Synthetic aperture radar is also used in ocean applications. Oil spills, both accidental and programmed, are imaged and the absence of radar return from the oil-covered surface is related to the damping of capillary and short gravity waves by the surface film.

Author

N71-37862*# Michigan Univ., Ann Arbor. Infrared and Optics Lab.

WATER-DEPTH MEASUREMENT BY WAVE REFRACTION AND MULTISPECTRAL TECHNIQUES Technical Report, 1 Jul. 1969 - 30 Sep. 1970

W. L. Brown, F. C. Polcyn, A. N. Sellman, and S. R. Stewart

Aug. 1971 49 p refs

(Contract NAS9-9784)

(NASA-CR-123194; WRL-31650-31-T) Avail: NTIS CSCL 20F

Two remote sensing techniques which measure water depth were investigated. One technique involves photographic observation of wave refraction phenomena and of wave length changes measured in Fourier transforms. The transforms were obtained by optical processing. Test sites near Puerto Rico and Barbadoes were used to study wave changes which occur near nonuniform bottom profiles of shallow reefs. The second technique

makes use of multispectral scanner to measure radiation reflected from the ocean floor. Measurement occurs in several spectral intervals in the visible region. The depth is calculated when the ratio of signals in pairs of spectral bands is taken. The technique was tested for sloping sandy beach gradients, as well as for coral reef areas which contained a variety of materials of different reflectances. Examples of computer-generated depth maps are included.

Author

N71-37824# Florida Atlantic Univ., Boca Raton. Remote Sensing and Interpretation Lab.

TIDEWATER SHORELINES IN BROWARD AND PALM BEACH COUNTIES, FLORIDA: AN ANALYSIS OF CHARACTERISTICS AND CHANGES INTERPRETED FROM COLOR, COLOR INFRARED AND THERMAL AERIAL IMAGERY

L. Alan Eyre Jun. 1971 30 p ref

(Contracts N00014-67-A-0320-0003; Nonr-4761(OO))

(AD-727630; TR-11) Avail: NTIS CSCL 14/5

In South Florida, pressures to extend and modify tidewater shorelines are very strong. These modifications include canal excavations, dredging and filling, bulkheading, erection of sea walls, and dock construction. Access to tidewater is much coveted and competition for such access is keen. Using color infrared aerial photography flown at 5000 ft., eight types of tidal shorelines are distinguished in a portion of NASA Test Site 164. Comparisons are made with other imagery, including high-altitude (80,000 ft.) photography and that from the Reconafax and Bendix Thermal Infrared sensor systems; and the degree to which these shoreline types are observable is noted. Some changes over time are also indicated, in particular the extent of additional modifications during a period of approximately one year.

Author (GRA)

N72-11319*# Earth Satellite Corp., Washington, D.C.
US FISHING INDUSTRY PARTICIPATION IN NASA'S EARTH RESOURCES SURVEY PROGRAM: COMMUNICATIONS BETWEEN NASA AND THE US FISHING INDUSTRY Final Report

P. M. Maughan, A. D. Marmelstein, K. Hecht, G. C. Broadhead (Living Marine Resources, Inc.), F. G. Alverson (Living Marine Resources, Inc.), C. G. Peckham et al. Mar. 1971 160 p refs Prepared in cooperation with Living Marine Resources, Inc., San Diego, Calif.

(Contract NASw-2133)

(NASA-CR-123202) Avail: NTIS CSCL 08A

A study to evaluate the applications of remote sensing in commercial fishing is reported, and the basis for effective communications between NASA and the U.S. fishing industry are established. Detailed information is presented in the following areas: organization of the fishing complex and communication levels within and between the components; organization of the fishing industry and the communications within and between both selected fisheries and various industry groups; relationships and communications between federal, state, and local government agencies and the fishing industry; relationships and communications between international and regional fisheries commissions; and intergovernmental agency relationships relevant to the fishing industry. It will be necessary to educate those individuals having access to the techniques and resultant data, and channels for distribution of the information to selected fisheries are recommended. Procedures for feedback information loops are also established.

N.E.N.

N72-12265*# Geological Survey, Menlo Park, Calif.

REMOTE SENSING IN MARINE GEOLOGY: ARCTIC TO CARIBBEAN

Paul R. Carlson *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 17 p refs

Avail: NTIS CSCL 08G

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The applications of remote sensing to coastal dynamics of both nearshore and offshore waters are discussed. Results of aerial photographic analysis of four areas are presented. The study areas include the Arctic (Beaufort Sea), the Pacific Northwest, San Francisco Bay, and St. John, Virgin Islands (Project Tektite).
Author

**N72-12296*# Geological Survey, Miami, Fla.
DETECTION AND IDENTIFICATION OF BENTHIC COMMUNITIES AND SHORELINE FEATURES IN BISCAYNE BAY**

Milton C. Kolipinski and Aaron L. Higer *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 16 p refs Sponsored by NASA

Avail: NTIS HC \$6.00/MF \$0.95 CSCL 08B

Progress made in the development of a technique for identifying and delineating benthic and shoreline communities using multispectral imagery is described. Images were collected with a multispectral scanner system mounted in a C-47 aircraft. Concurrent with the overflight, ecological ground- and sea-truth information was collected at 19 sites in the bay and on the shore. Preliminary processing of the scanner imagery with a CDC 1604 digital computer provided the optimum channels for discernment among different underwater and coastal objects. Automatic mapping of the benthic plants by multiband imagery and the mapping of isotherms and hydrodynamic parameters by digital model can become an effective predictive ecological tool when coupled together. Using the two systems, it appears possible to predict conditions that could adversely affect the benthic communities. With the advent of the ERTS satellites and space platforms, imagery data could be obtained which, when used in conjunction with water-level and meteorological data, would provide for continuous ecological monitoring.
A.L.

N72-12305*# National Oceanic and Atmospheric Administration, Washington, D.C.

NOAA'S OCEANOGRAPHY STUDIES UNDER THE EARTH RESOURCES SURVEY PROGRAM

E. Paul McClain *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1971 12 p refs Sponsored by NASA

Avail: NTIS HC \$6.00/MF \$0.95 CSCL 08C

Some results are presented of Earth Resources Survey Program studies conducted on: (1) Defining and developing methods of suppressing system noise and cloud contamination in satellite measurements of infrared window radiation. (2) Relating sea surface temperature patterns in the Gulf Stream and Gulf of Mexico to associated thermal front structure with aid of infrared data from Nimbus orITOS. (3) Testing the feasibility of mapping sea surface roughness and low level wind speed over tropical oceans by means of ATS imagery in sun glitter zones. (4) Microwave radiometer measurements from aircraft and their usefulness and limitations for all-weather mapping of surface roughness, sea ice conditions, and possible surface temperature. (5) Evaluation of scanning radiometer data from ITOS for purposes of mapping snow and ice conditions.
Author

N72-12307*# Oregon State Univ., Corvallis. Dept. of Oceanography.

REMOTE SENSING AND THE PELAGIC FISHERIES ENVIRONMENT OFF OREGON

William G. Percy *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 12 p refs

(Contracts N62306-70-C-0414;

Bur-Com-Fish-14-17-17-0002-333)

Avail: NTIS HC \$6.00/MF \$0.95 CSCL 08A

Remote sensing oceanography at Oregon State University is part of a multidisciplinary research program: (1) to learn more about nearshore oceanographic processes and how they affect

the production of marine life and the availability of albacore tuna; and (2) to provide fishermen with information in near real time that will be useful in scouting for albacore concentrations.

Author

N72-12308*# National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.

REMOTE SENSING OF OCEAN COLOR FROM AIRCRAFT

c14

G. L. Clarke and G. C. Ewing *In* its 3d Ann. Earth Resources Program Rev., Vol. 3 1970 12 p refs

Avail: NTIS HC \$6.00/MF \$0.95 CSCL 14E

Over 3000 ocean spectra of sunlight backscattered from the upper layers of the sea have been obtained at flight altitudes to 10,000 feet together with detailed ground truth. These spectra are from stations which include a wide range of water masses differing as to biological and physical condition. This data bank and the analysis already performed demonstrates the probable feasibility of using ocean color as a parameter to locate areas of special significance to physical oceanographers and marine biologists from aircraft and satellites.
Author

N72-12309*# National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.

THE REMOTE SENSING NEEDS OF ARCTIC GEOPHYSICS

William J. Campbell *In* its 3d Ann. Earth Resources Program Rev., Vol. 3 1970 15 p refs

Avail: NTIS HC \$6.00/MF \$0.95 CSCL 08L

The application of remote sensors for obtaining geophysical information of the Arctic regions is discussed. Two significant requirements are to acquire sequential, synoptic imagery of the Arctic Ocean during all weather and seasons and to measure the strains in the sea ice canopy and the heterogeneous character of the air and water stresses acting on the canopy. The acquisition of geophysical data by side looking radar and microwave sensors in military aircraft is described.
Author

N72-12310*# National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.

MEASUREMENT OF WATER DEPTH BY MULTISPECTRAL RATIO TECHNIQUES

F. C. Polcyn *In* its 3d Ann. Earth Resources Program Rev., Vol. 3 1970 11 p

Avail: NTIS HC \$6.00/MF \$0.95 CSCL 08C

The technique for measuring the depth of water using a multispectral scanner is discussed. The procedure takes advantage of the absorption properties of different wavelengths of light. Making use of the property of the selected transmission of light at different wavelengths, an equation was developed relating the outputs of at least two channels of multispectral scanner to measure water depth.
Author

N72-12313*# Atlantic Oceanographic and Meteorological Labs., Miami, Fla. Sea-Air Interaction Lab.

LASER OBSERVATIONS OF WAVE GROWTH AND FOAM DENSITY FOR FETCH LIMITED 25 M/SEC WINDS

Duncan B. Ross and Vincent Cardone (N. Y. Univ. Dept. of Oceanog. and Meteorol.) *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 27 p refs

Avail: NTIS HC \$6.00/MF \$0.95 CSCL 08C

The variability of sea surface conditions has been observed from a low flying aircraft by a laser wave profiling system for fetch limited wind speeds of 25 M/SEC. in the North Sea. Wave profiles obtained with the laser system have been analyzed and show that wave growth occurs simultaneously at all frequencies and that an equilibrium value for the higher frequency components is eventually reached, but not before substantially higher (overshoot) values are obtained. Simultaneous photography of the surface has been analyzed and show that 32 percent of the

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surface is covered with white caps, foam and streaks. This result is in good agreement with a semi-empirical relationship incorporating both the wind speed and the local wave spectrum which predicts 26 percent white water for the conditions observed. Author

N72-12314*# California Univ., La Jolla. Visibility Lab.
WHITECAP COVERAGE FROM AERIAL PHOTOGRAPHY
Roswell W. Austin /In NASA. Manned Spacecraft Center
3d Ann. Earth Resources Program Rev., Vol. 3 1970 11 p
refs Supported by Naval Oceanog. Office

Avail: NTIS HC \$6.00/MF \$0.95 CSCL 08C

A program for determining the feasibility of deriving sea surface wind speeds by remotely sensing ocean surface radiances in the nonglitter regions is discussed. With a knowledge of the duration and geographical extent of the wind field, information about the conventional sea state may be derived. The use of optical techniques for determining sea state has obvious limitations. For example, such means can be used only in daylight and only when a clear path of sight is available between the sensor and the surface. However, sensors and vehicles capable of providing the data needed for such techniques are planned for the near future; therefore, a secondary or backup capability can be provided with little added effort. The information currently being sought regarding white water coverage is also of direct interest to those working with passive microwave systems, the study of energy transfer between winds and ocean currents, the aerial estimation of wind speeds, and many others. Author

N72-12315*# National Aeronautics and Space Administration.
Manned Spacecraft Center, Houston, Tex.
ON THE USE OF A SINGLE BLUE BAND IN OCEANOGRAPHY
John W. Sherman, III /In its 3d Ann. Earth Resources Program
Rev., Vol. 3 1970 10 p refs
Avail: NTIS HC \$6.00/MF \$0.95

The selection of a single blue band to quantitatively measure ocean chlorophyll is dependent upon the altitude and spectral bandwidth of the filter. These relationships are discussed, and the conclusion made that a blue band from 0.44 to 0.50 microns would best serve this oceanographic application. Author

N72-12316*# Naval Research Lab., Washington, D.C.
THE VARIATION OF RADAR CROSS SECTION WITH WIND c07
N. W. Guinard /In NASA. Manned Spacecraft Center 3d Ann.
Earth Resources Program Rev., Vol. 3 1970 1 p

Avail: NTIS HC \$6.00/MF \$0.95 CSCL 17I

X-band (8910 megahertz) and C-band (4455 megahertz) measurements indicate that two domains exist in the variation of radar cross section with wind at incident angles far from the normal. The first domain for flow windspeeds is characterized by a rapid variation of radar cross section with wind and the second domain at higher windspeeds by an asymptotic approach to an upper limit (saturation). The transaction between the two domains occurs at a windspeed of approximately 10 knots. Recent Joint Ocean Surface Study I observations tend to confirm this observation and offer additional proof of the validity of a composite surface model which relates the radar cross section of the sea to the wave-height spectrum. This confirmation was obtained by comparing the radar cross section measured by the four-frequency radar system with the radar cross section calculated from the ocean wave-height spectrum that had been determined by the optical analysis of photographs taken at the same time. A possible explanation for the wind variation of the radar cross section of the open ocean also was evolved, based on radar measurements in a wave tank under various wind conditions and subsequent comparison with optically determined spectra. Author

N72-12317*# Naval Research Lab., Washington, D.C. E. O. Hulburt Center for Space Research.
NANOSECOND RADAR OBSERVATIONS OF THE OCEAN SURFACE FROM A STABLE PLATFORM c07
B. S. Yaplee, A. Shapiro, B. D. Au, D. L. Hammond, and E. A. Uliana /In NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 15 p

Avail: NTIS HC \$6.00/MF \$0.95 CSCL 17I

The measurement of ocean surface waves with a nanosecond radar pulse from a fixed platform at vertical incidence is discussed. By reducing the pulse width of radar until the pulse width resolves the vertical water wave structure, a set of radar returns is available to describe the ocean surface characteristics which differs from returns obtained by conventional radars. A block diagram of the radar and the principles of operation are presented. Author

N72-12318*# Naval Research Lab., Washington, D.C. E. O. Hulburt Center for Space Research.
PASSIVE MICROWAVE STUDIES c14
James P. Hollinger /In NASA. Manned Spacecraft Center
3d Ann. Earth Resources Program Rev., Vol. 3 1970 14 p
refs

Avail: NTIS HC \$6.00/MF \$0.95 CSCL 14B

The application of passive microwave techniques from airborne and surface platforms for oceanography measurements is discussed. The program is designed to determine: (1) the optimum system parameters, (2) measurement techniques, and (3) the physical phenomena to enable unambiguous all-weather determination of the sea surface properties of sea roughness, surface wind fields, temperature, salinity, sea ice, and pollution. The advantages and disadvantages of the airborne and fixed station operations are examined. Author

N72-12319*# New York Univ., N.Y. Dept. of Meteorology and Oceanography.
THE INTEGRATION OF REMOTE SENSING DATA INTO GLOBAL WEATHER PREDICTION, WAVE FORECASTING, AND OCEAN CIRCULATION COMPUTER BASED SYSTEMS c08

Willard J. Pierson, Jr. /In NASA. Manned Spacecraft Center
3d Ann. Earth Resources Program Rev., Vol. 3 1970 27 p
refs

(Contracts N62306-70-A-0075; N00014-67-A-0467-0012)

(Contrib-98) Avail: NTIS HC \$6.00/MF \$0.95 CSCL 09B

Data from infrared imaging systems and satellite infrared spectrometer (SIRS) for determining sea surface temperature and the atmospheric structure in cloudless areas over the oceans are discussed. Although some interpretations differ, it is clear that simultaneous measurements of radar sea return and passive microwave temperature will provide estimates of the wind speed, and perhaps wind direction, over the oceans, especially in cloudless areas, for a wide range of wind speeds. The problem of integrating the data that would be obtained by a spacecraft, especially one with a combination radar-radiometer, into global analysis procedures for meteorological, wave, and oceanographic predictions is described. Author

N72-12344# Joint Publications Research Service, Washington, D.C.

MARINE GEOLOGY AND GEOPHYSICS
6 Dec. 1971 811 p refs Transl. into ENGLISH from Morsk. Geol. i Geofiz (Riga), no. 1, 1970 p 3-4 and 193-196
(JPRS-54622) Avail: NTIS HC \$9.00/MF \$0.95

The accuracy of isoline maps of the anomalous magnetic field is examined on the basis of the magnetic survey process and the compilation and use of the maps. A new calculation of magnetic-survey accuracy, which includes not only the accuracy of field-intensity measurements on survey traverse routes but also the accuracy of interpolating between the traverse routes, is furnished. Errors in interpolating field strength values in the areas between traverse routes and magnetic-coordinate and carto-

graphic-scale errors are discussed.

Author

N72-12403* Virginia Univ., Charlottesville. Dept. of Environmental Science.

AERIAL PHOTOGRAPHIC STUDIES OF THE COASTAL WATERS OF NEW YORK AND LONG ISLAND

Mahlon G. Kelly /In Philco-Ford Corp. Sci. Study Utilizing Philco-Ford Electron. Enhancement Viewer 30 Jun. 1971 7 p

Avail: NTIS CSCL 14E

Aerial and satellite photographs show significant patterns of distribution of coastal bottom (benthic) vegetation and suspended materials in the water. A knowledge of these distributions, which are impossible to perceive from the surface, is obviously an important factor to understand coastal ecological processes and to aid in future planning. Benthic vegetation, as seen from the air, is a good indicator of environmental conditions in tropical clear-water areas. Work is being extended to temperate turbid waters. Water color patterns caused by backscattered light from suspended materials are related to oceanographic conditions such as water mass boundaries, chlorophyll concentration, phytoplankton populations, suspended sediments, and the effect of man's sewage and dredging.

Author

N72-15323# Communications Research Centre, Ottawa (Ontario). Dept. of Communications.

A RADIOMETER METHOD FOR DETERMINING THE THICKNESS OF SEA ICE

T. R. Hartz May 1971 14 p refs

(CRC-TN-1217) Avail: NTIS

The use of airborne radiometers to monitor emissions from sea ice at ultrahigh frequencies is considered, and, in particular, the possibility of obtaining ice thickness information by this means under certain limiting conditions is examined. It is known that radiation in the indicated frequency range can penetrate a significant distance in the ice. Consequently, for a positive thermal gradient with increasing depth, and for dielectric absorption properties that are either constant or also increasing with depth, it is shown that the observable radiation should be a characteristic function of ice thickness and of observing frequency. Observations on several frequencies can then be expected to yield an estimate of ice thickness. The expected results, the range of conditions under which the method might be applicable, and the kind of auxiliary information that might facilitate the data analysis are discussed.

Author

N72-15385# Michigan Univ., Ann Arbor. William Run Labs. **MULTISPECTRAL RADIATIVE CHARACTERISTICS OF ARCTIC SEA ICE AND TUNDRA** Final Report

Robert Horvath and William L. Brown Jul. 1971 78 p refs (Contract Nonr-426(00))

(AD-731070; Rept-027980-2-F) Avail: NTIS CSCL 08/12

Multispectral remote sensor data acquired from an aircraft in the vicinity of Barrow, Alaska are analyzed and the results of the analysis are presented. The spectral, spatial, and temporal radiation characteristics measured directly by the calibrated sensors for a variety of targets are compared and discussed. These data are then extended and extrapolated with the aid of ground measurements in order to arrive at estimates of the radiative components of the total energy budget for these targets.

Author (GRA)

N72-16088# Development and Resources Transportation Co., Silver Spring, Md.

AUTOMATIC PROCESSING OF ARCTIC PACK ICE DATA OBTAINED BY MEANS OF SUBMARINE SONAR AND OTHER REMOTE SENSING TECHNIQUES c13

Leonard A. LeSchack, William D. Hibler, III (Army Cold Reg. Res. and Eng. Lab., Hanover, N. H.), and Frederick H. Morse (Maryland Univ., College Park) /In AGARD Propagation

Limitations in Remote Sensing Oct. 1971 19 p refs Original Contains Color Illustrations

(Contract N00014-70-C-0110; NR Proj. 307-322)

Avail: NTIS HC \$6.00/MF \$0.95

Three remote sensors have been used for examining the upper and under surface of the Arctic ice pack; an upward looking sonar mounted on a nuclear submarine transiting beneath the ice, producing an under ice profile, a vertically mounted airborne laser, producing an upper ice surface profile, and an airborne infrared scanner in the 8-14 micron range, producing a heat picture of the ice surface. The sonar data were digitized and analyzed. Frequency distribution of amplitudes of the profile data indicates that young ice has a sharp, uni-modal distribution; older, more jumbled ice has a broad-based uni-modal distribution and old, much ridged ice has a bi-modal distribution. The same analytical techniques were used to process airborne laser profile data of pack ice. Analysis of profiles of multi-year ice and young ice show that the young ice has greater amplitude of all ridge spacings shorter than 20 m than does the multi-year ice. Airborne infrared scanning imagery of pack ice was color-contoured using a spatial data system. A simplified energy balance equation was used as a method to determine thickness of ice scanned.

Author

N72-16089# Communications Research Centre, Ottawa (Ontario).

THEORY AND FIELD TESTS OF A MICROWAVE RADIOMETER FOR DETERMINING SEA ICE THICKNESS c14

A. W. Adey /In AGARD Propagation Limitations in Remote Sensing Oct. 1971 10 p refs

Avail: NTIS HC \$6.00/MF \$0.95

A theoretical analysis of UHF emissions from sea ice and/or sea water is outlined. A radiometer system designed to observe these emissions operating at frequencies from 400 MHz to 1.5 GHz has been designed and built. The results of initial ground based and airborne tests of this instrument are presented. Initial results tend to confirm the theoretical analysis and predictions.

Author

N72-16094# Naval Research Lab., Washington, D.C. Hulbert (E. O.) Center for Space Research.

WAVE HEIGHT MEASUREMENTS WITH A NANOSECOND RADAR

B. S. Yaplee, A. Shapiro, D. L. Hammond, and E. A. Uliana /In AGARD Propagation Limitations in Remote Sensing Oct. 1971 13 p ref

Avail: NTIS HC \$6.00/MF \$0.95

A radar system has been developed with a sufficiently narrow pulse width to resolve the vertical wave structure of ocean waves. The radar illuminates a 70 cm diameter spot on the ocean at normal incidence and three wave poles are placed in a delta configuration around the spot for ground truth measurements. A corner reflector is placed at the center of the antenna beam to calibrate radar measurements both in range and amplitude. Wind conditions are monitored using the tower's anemometer. These ground truths are then used in relating the radar measurements to actual sea conditions. The wave heights encountered range from two to six feet. Results of the radar measurements are presented and compared with simultaneous wave pole measurements of the sea surface structure.

Author

N72-16095# Naval Research Lab., Washington, D.C.

REMOTE PASSIVE MICROWAVE MEASUREMENTS OF THE SEA SURFACE c13

James P. Hollinger /In AGARD Propagation Limitations in Remote Sensing Oct. 1971 7 p refs

Avail: NTIS HC \$6.00/MF \$0.95

The important potential of all-weather determination of ocean surface wind fields by means of remote passive microwave sensing is discussed. The wind speed dependence of the microwave brightness temperature of the sea is interpreted as

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resulting primarily from small scale wave structure at wind speeds below about 15 to 20 m/sec and from the increasing coverage of sea foam at higher wind speeds. Measurements of these two effects are presented and the characteristics of each described separately. The two effects are combined to estimate the total microwave brightness temperature dependence of a wind driven sea as viewed from a satellite. Taken together the two effects allow the determination of ocean surface wind fields over the entire range of wind speeds. Author

N72-16096# Naval Research Lab., Washington, D.C.
REMOTE SENSING OF OCEAN EFFECTS WITH RADAR, c13
N. W. Guinard /in AGARD Propagation Limitations in Remote Sensing Oct. 1971 12 p refs
Avail: NTIS HC \$6.00/MF \$0.95

Remote sensing of ocean surface effects is reported with the objective of evolving theoretical models of these effects to aid systems design and the acquisition of data in situ and in laboratory simulations to determine appropriate parametric relationships. The four-frequency radar system, a calibrated airborne measurement facility, has been extensively used for the in situ data collection. The radar is capable of operating sequentially on X band (8910 MHz), C band (4455 MHz), L band (1228 MHz), and P band/UHF (428 MHz) with both horizontal and vertical polarization. A review of the theoretical models and the parametric relationships is presented. In the course of the study, two new techniques for remotely sensing wave spectra have been evolved and used to obtain an explanation for the wavelength dependence of the sea return in low wind fields. Author

N72-16099# Wisconsin Univ., Middleton. Geophysical and Polar Research Center.
ELECTROMAGNETIC SOUNDING OF ICE THICKNESS c13
C. R. Bentley and J. W. Clough /in AGARD Propagation Limitations in Remote Sensing Oct. 1971 7 p refs
Avail: NTIS HC \$6.00/MF \$0.95

The efficiency of ice thickness determination in Antarctica and elsewhere has been vastly improved by the use of electromagnetic sounding. The electromagnetic sounder, which is basically a low-frequency radar system, is easily adapted to use in an aircraft, and is capable of measuring thicknesses of ice as great as 4 km. Since pure ice has an extremely low conductivity, electromagnetic wave propagation at a frequency of around 35 MHz is essentially non-dispersive. Absorption takes place in close accordance with the high-frequency tail of a Debye relaxation spectrum and is highly temperature dependent, the attenuation factor varying by 50-100 db/km over the range of temperatures (about 60 C) found in different glaciers. The attenuation in very cold ice is so small that it is substantially less than the normal spherical-spreading loss. Losses occurring at the reflecting boundary are about 10-20 db for most earth materials, but may be more if the boundary is rough. At a sharp ice-sea water boundary, however, the reflection loss is only 0.5 db. Author

N72-16105# Lille Univ. (France). Lab. d'Optique Atmospherique.
ANALYSIS OF RADIOMETRIC INFRARED SEA TEMPERATURE MEASUREMENTS c13
P. Y. Deschamps, P. Lecomte, and J. C. Vanhouette /in AGARD Propagation Limitations in Remote Sensing Oct. 1971 9 p refs In FRENCH
Avail: NTIS HC \$6.00/MF \$0.95

Correction procedures are described that provide real temperature data for a sea surface from infrared radiometric measurements. The primary error source is reflection of sky radiation from the surface; it is corrected by real measurements at sea level. The secondary error is caused by transmission through the air layer between the radiometer and the sea; it is

corrected theoretically. Above described corrections provide absolute temperature values for the sea surface with an accuracy of about 0.1 degree. Transl. by G.G.

N72-16107# National Environmental Satellite Center, Washington, D.C.
FACTORS AFFECTING THE ACCURACY OF SEA SURFACE TEMPERATURE MEASUREMENTS FROM ITOS-SR DATA c13
J. Leese, W. Pichel, B. Goddard, and R. Brower /in AGARD Propagation Limitations in Remote Sensing Oct. 1971 13 p refs
Avail: NTIS HC \$6.00/MF \$0.95

The improved TIROS satellite sensor package contains a two channel scanning radiometer which operates in the .52- to .73-micron visible range and the 10.5- to 12.5-micron infrared water vapor window. One of the primary applications of the IR data is the operational determination of global sea-surface temperatures. The objective is to make statistically-integrated measurements, over areas approximately 100 km on a side, which agree with ground truth measurements within a root-mean-square deviation no larger than 1 C. A quantitative error analysis of the ITOS system, combined with tests on real data, shows that the objective should be reached using only IR data in regions where the magnitude of the temperature gradient is less than 2 C per 100 km. In regions where the temperature gradients are 2 to 4 C per 100 km the inclusion of SR data from the visible channel to reduce cloud contamination errors should place the accuracy objective within accessible limits. Author

N72-16112# TRW Systems Group, Redondo Beach, Calif.
SEA BRIGHTNESS TEMPERATURES AT MICROWAVE FREQUENCIES c13
R. J. Wagner and P. J. Lynch /in AGARD Propagation Limitations in Remote Sensing Oct. 1971 16 p refs
Avail: NTIS HC \$6.00/MF \$0.95

A complete geometrical optics theory of rough-surface emission and scattering is developed which accounts explicitly for surface shadowing effects and the contributions of double-scattered radiation. The validity of the emission theory is tested by comparing the results with a case for which the exact solution is known. A theorem is proved which establishes, for the domain of geometrical optics, the existence of rigorous upper and lower bounds to the effects of surface roughness on brightness temperatures; the Peake representation yields the upper bound provided shadow corrections, at least, are included, while an alternative representation provides the lower bound. Microwave brightness temperatures for the sea are calculated for a cylindrical roughness model. Double scatter contributions are shown to be appreciable and, with their inclusion, accurate calculation of brightness temperatures is possible. A model for a wind-driven spray layer is integrated into the theory and semi-empirical corrections for foam added; the results agree well with rough-sea data. Author

N72-17271*# North American Rockwell Corp., Downey, Calif. Space Div.
DEVELOPMENT OF A SATELLITE MICROWAVE RADIOMETER TO SENSE THE SURFACE TEMPERATURE OF THE WORLD OCEANS
G. M. Hidy, W. F. Hall, W. N. Hardy, W. W. Ho, A. C. Jones, A. W. Love, M. J. VannMell, H. H. Wang, and A. E. Wheeler
Washington NASA Feb. 1972 278 p refs
(Contract NAS1-10106)
(NASA-CR-1960) Avail: NTIS CSCL 08C

A proposed S-band radiometer for determining the ocean surface temperature with an absolute accuracy of + or - 1 Kelvin and a resolution of + or - .1 Kelvin was placed under the Advanced Applications Flight Experiment for further development into Nimbus readiness state. The results of assessing the following are described: effects due to the state of the sea

surface, effects caused by the intervening atmosphere, and effects associated with imperfections in the instrument itself. An extensive sea truth program is also described for correlation of aircraft test flight measurements or of satellite remote measurement to in-situ data. An improved radiometer design is a modified Dicke-switch type with temperature stabilized, microwave integrated circuit, front-end and with a pulsed injection-noise nulling system. The radiometer has a multimode rectangular horn antenna with very low ohmic losses and a beam efficiency of 98% or better. Author

N72-17293# SACLANT ASW Research Center, La Spezia (Italy).

OBSERVATIONS OF AN OCEANIC FRONTAL SYSTEM EAST OF MALTA IN MAY 1971 (MAY FROST)

Ola M. Johannessen, Federico DeStrobel, and Claude Gehin 15 Aug. 1971 30 p refs

(AD-730995; SACLANTCEN-TM-189) Avail: NTIS CSCL 08/3

Some preliminary results are presented from a study of an oceanic front east of Malta that was made in May 1971 using both a ship and an airborne radiation thermometer (ART). During the first nine days of the investigation a major frontal system was located extending southwards approximately along 15 degrees 20 minutes E from the southern part of Sicily to 35 degrees 30 minutes N, at which latitude it curved eastwards, probably due to intruding low-salinity surface-water from the Atlantic. During the second nine days of the cruise the frontal structure and dynamics were studied in detail along latitude 36 degrees N. The temperature structure and the water masses characteristics are described, as well as the response of the front to a sudden increase of the wind speed. Author (GRA)

N72-17294# North American Rockwell Corp., Downey, Calif. Space Div.

COASTAL BATHYMETRIC PLOTTING Final Report, 1 May - 30 Sep. 1971

David T. Hodder, Phillip B. Chandler, and Gary A. McCue 30 Sep. 1971 57 p refs

(Contract N00014-70-C-0370; NR Proj. 387-048)

(AD-730830; SD-71-763) Avail: NTIS CSCL 08/10

The research is concerned with the development of improved passive techniques for automatic bathymetric plotting in turbid, relatively shallow coastal waters. Initially the technique uses narrower slicing (200 Å) bandpass interference filters than have heretofore been utilized in multispectral photography of coastal waters. This is done to reject all of the non-image forming light for bottom photography. Coupled with this is an attempt to adequately characterize (for calibration of the plotting) the water column by a modulation transfer function (MTF) derived either from laser or photographic techniques. Finally, widely-spaced repetitive imagery of identical sites under randomly varying conditions of water column transmission properties were employed to linearly combine, by computer, film isodensity contours. These isodensity contours may be due to combinations of suspended sediment and bottom relief. The former are considered random variations and the latter relatively stable features. This statistical approach has yielded a superior estimate of actual depth contours, since the random sediment effects average out and the bottom features reinforce. Finally, additive multicolor additive processing techniques were examined and found to require normalization for use in the image merging from multiple missions outlined above. This latter work led to an additional spectral reflectivity difference ratioing concept for depth determination and characterizing coastal waters. Author (GRA)

N72-17300# Naval Oceanographic Office, Washington, D.C.

BIRDS EYE 6-70, 2-15 DECEMBER 1970 Informal Report

R. F. Freeman and M. R. Monroe Oct. 1971 74 p

(AD-732922; NOO-IR-71-7) Avail: NTIS CSCL 08/12

BIRDS EYE 6-70 was a regularly scheduled Arctic Ocean ice reconnaissance mission over areas east and west of Greenland

between 2 and 15 December 1970. Ice observations were taken under twilight or moonlight conditions. An infrared scanner operated over the site of recent volcanic activity on Jan Mayen Island. GRA

N72-17307# Army Coastal Engineering Research Center, Washington, D.C.

AN AERIAL PHOTOGRAPHIC TECHNIQUE FOR BEACH EROSION SURVEYS IN NORTH CAROLINA

Donald B. Stafford Oct. 1971 126 p refs

(AD-732833; TM-36) Avail: NTIS CSCL 08/2

The study presents a procedure developed to use existing aerial photographs to survey beach erosion. The use of the procedure is illustrated by data from Onslow and Carteret Counties in North Carolina. A preliminary evaluation of the results obtained in these two counties is given. The procedure is applicable to a variety of conditions and has important advantages over other methods of collecting beach erosion data. The procedure consists of selecting stable reference points on aerial photographs taken in different years and measuring between the stable reference points and points on the transient beach. The measurements are converted to ground distances, and the difference in ground distance is computed. The difference in ground distance represents the change in location of the beach between the dates of the aerial photographs and is converted to an annual rate of change by dividing by the time interval. The change in two locations on the beach, the dune line and the high water line, is determined. Author (GRA)

N72-18119# TRW Systems Group, Redondo Beach, Calif.

MARINE RESOURCES SPECTROMETER EXPERIMENT Final Report

R. C. Ramsey 29 Nov. 1971 89 p

(Contract N62306-71-C-0153)

(AD-733685) Avail: NTIS CSCL 06/3

Spectral contrast ratios in the visible region of the spectrum between the radiance from fish schools and adjoining water, were obtained by an airborne spectrometer. Most of the data presented are of menhaden just after capture in a purse seine, and of natural mullet schools. These data were taken from a helicopter near the Mississippi Delta. Additional data for natural anchovy schools were obtained off the coast of Southern California from a seaplane. A repeatable signature for the mullet was definitely established. Useful contrast ratios were not obtained for the menhaden or anchovy schools. For the menhaden, this was due to the muddy water caused by seining operations. Author (GRA)

N72-18343*# Bellcomm, Inc., Washington, D.C.

THE BRIGHTNESS TEMPERATURE OF THE AIR-SEA INTERFACE AT MICROWAVE FREQUENCIES

C. C. H. Tang 21 Jan. 1972 32 p refs

(Contract NASw-417)

(NASA-CR-125672; TM-72-1011-1) Avail: NTIS CSCL 08C

Available results of observation have shown that at nadir the brightness temperature of the sea surface at 19.35 GHz increases linearly with increasing wind speed. The computational results of the modified theoretical model presented are in good agreement with the measurement results both at nadir and other angles. The model depicts that, for a fully developed sea driven by the wind with speed above 5 m/sec, the air in the transitional zone immediately above the air-sea interface is mixed with sea water droplets from bursting air bubbles. The droplet concentration has a profile tapering off to zero at a certain height. The dielectric constant of the inhomogeneous droplet profile is thus both a function of the height above the interface and the wind speed. Both the inhomogeneity effect and the possible attenuation effect of the droplet concentration have been considered. Author

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N72-18360# National Environmental Satellite Center, Washington, D.C.

LIMITS ON THE ACCURACY OF INFRARED RADIATION MEASUREMENTS OF SEA-SURFACE TEMPERATURE FROM A SATELLITE

Charles Braun Dec. 1971 31 p refs
(NOAA-TM-NESS-30) Avail: NTIS

The accuracy with which measurements of sea surface temperature can be made through a cloud-free atmosphere with either a single- or two-channel radiometer is discussed. The single-channel radiometer is assumed to operate in one of three infrared spectral regions. The overall accuracy of radiometric temperature measurements made with this instrument when viewing at normal incidence is estimated to be 2 C to 3 C for intervals (I) and (II) and 1 C to 1.5 C for interval (III), provided that independent measurements are made of the atmospheric temperature and water vapor profiles, with a separate instrument. The two-channel radiometer is assumed to operate in two infrared spectral regions to eliminate the effects of atmospheric water vapor absorption. Author

N72-18408# Naval Postgraduate School, Monterey, Calif.
STUDY OF THE NEAR SHORE SURFACE CHARACTERISTICS OF WINDROWS AND LANGMUIR CIRCULATION IN MONTEREY BAY M.S. Thesis

Alexander Maratos Sep. 1971 71 p refs
(AD-733197) Avail: NTIS CSCL 08/3

Observations of the spacing and angle of windrows with respect to the wind speed and direction were conducted in Monterey Bay, using aerial photographs taken of windrow accumulations on 13, 20, 27 April and 3, 11 May 1971. The spacing of windrows was found to depend upon wind speed. These windrows are indicative of the presence of helical vortices in the surface waters, and the data support Langmuir's contention that the vortices are wind-driven. Deflection angles showed small variation to the left and right of the wind with 0 degrees being the most common angle. No correlation was found between depth of the thermocline and row spacing. Author (GRA)

N72-18467# Long Island Univ., Greenvale, N.Y. Science Engineering Research Group.

MULTISPECTRAL PHOTOGRAPHIC REMOTE SENSING OF COASTAL ENVIRONMENTS Final Technical Report

Edward Yost, Robert Anderson, Rajender Kalis, Vincent Posteraro, and Sondra Wenderoth 31 Jul. 1971 353 p refs
(Contract N00014-68-A-0284-0001; NR Proj. 387-041)
(AD-733691; SERG-TR-11) Avail: NTIS HC \$6.00/MF \$0.95 CSCL 14/5

Experiments to determine the usefulness of multispectral photography for the remote sensing of coastal water environments were conducted in northeastern Massachusetts, Long Island, New York, and Barataria Bay, Louisiana. Multispectral imagery was associated with in situ spectra and water sample analysis simultaneously obtained. Changes in the amplitude and shape of both the downwelling irradiance spectra and upwelling radiance spectra were found to be associated with the amount and type of particulate in suspension. Author (GRA)

N72-19431*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

OCEAN COLOR DETERMINATION THROUGH A SCATTERING ATMOSPHERE

Robert J. Curran Mar. 1972 34 p refs Submitted for publication
(NASA-TM-X-65849; X-651-72-58) Avail: NTIS CSCL 08C

Measurements made of the surface level albedo for ocean water containing various concentrations of phytoplankton indicate a strong correlation between wavelength dependent albedo ratios and phytoplankton chlorophyll concentration. To sense surface level albedo ratios from space platforms it is necessary to correct for the scattering and absorption properties

of the atmosphere for the wavelengths in question. Atmospheric scattering models were constructed to calculate corrections at two wavelengths, 0.46 and 0.54 millimicrons. Assuming a natural background uncertainty in the aerosol optical depth of 0.1, it is found that the chlorophyll concentration may be determined to within one standard deviation of from 0.5 to 2.5 milligrams per cubic meter. By remotely sensing the aerosol optical depth to a greater accuracy it appears feasible to detect chlorophyll concentrations to uncertainty approaching 0.1 milligram per cubic meter. Author

N72-19440# California Univ., Berkeley. Hydraulic Engineering Lab.

DETERMINATION OF DIRECTIONAL SPECTRA OF OCEAN WAVES FROM GAGE ARRAYS

Narayana N. Paniker Aug. 1971 332 p refs

(Contract DACW72-68-C-0016)
(AD-732497; HEL-1-18) Avail: NTIS HC \$6.00/MF \$0.95 CSCL 08/3

Directional spectra may be thought of as the distribution of wave energy with respect to frequency and direction. The development of a comprehensive and general procedure for determining directional spectra and its testing and application are discussed in this report. Author (GRA)

N72-19449# Rosenstiel School of Marine and Atmospheric Sciences, Coral Gables, Fla.

MICROWAVE RADIOMETRY OF THE OCEAN Final Report

Claes Rooth and G. F. Williams, Jr. Jun. 1971 72 p refs
(Contract N62306-69-C-0301)

(AD-734076) Avail: NTIS CSCL 08/10

The work done under this contract has established a firmer foundation for the microwave part of the hypothesis proposed by Williams (1969). The authors determined the emissivities of foam samples at 3 cm, and confirmed from photographic analysis that there is some correlation between wind speed and foam coverage on the ocean. It is possible, and in fact likely, that there exists a family of such relationships, depending primarily on sea temperature, air temperature, and the degree of development of the sea. Quarterly progress reports for the period August, 1968 to February, 1971 are included. GRA

N72-19458# Development and Resources Transportation Co., Silver Spring, Md.

THE FEASIBILITY OF ADP OF AIRBORNE LINE SCAN IMAGERY FOR NEAR SHORE BATHYMETRY Technical Report, 1 Apr. - 1 Nov. 1971

Leonard A. LeSchack and D. E. McIvor Nov. 1971 27 p refs
(N00014-71-C-0327; NR Proj. 387-055)

(AD-734430; D/RT-6) Avail: NTIS CSCL 08/6

A study of the feasibility of applying automatic data processing techniques to airborne line-scan imagery of coastal areas for beach reconnaissance is presented. Preliminary work indicates that parallel microdensitometer scans of aerial photographs of a coastal area near Galveston, Texas, where ocean swell is visible, can be cross-correlated, both spatially and temporally, to extract wave length, wave angle, and wave speed. Author (GRA)

N72-20340*# TRW Systems Group, Redondo Beach, Calif.

ADVANCED STUDY OF GLOBAL OCEANOGRAPHIC REQUIREMENTS FOR EOS A/B: TECHNICAL VOLUME Final Report

Jan. 1972 293 p refs

(Contract NASw-2163)

(NASA-CR-125816; TRW-17683-6001-RO-00) Avail: NTIS CSCL 08C

Characteristics of the ocean are considered in terms of U.S. social, scientific and economic priorities and in terms of the measurements that can best be made from a spacecraft. The kinds of information needed to advance the basic ocean

sciences, to improve marine transportation and fisheries operations, and to provide information for pollution control are discussed. These information needs were related to sensor concepts and an optimum sensor complement is presented, together with orbital considerations. The data-gathering capabilities of an oceanographic spacecraft were considered in relation to those of terrestrial oceanographic programs, using airborne, surface, and submarine platforms. Data management problems are discussed and are considered to be solvable with current technology. Author

N72-20341* TRW Systems Group, Redondo Beach, Calif.
ADVANCED STUDY OF GLOBAL OCEANOGRAPHIC REQUIREMENTS FOR EOS A/B: APPENDIX VOLUME Final Report
 Jan. 1972 125 p refs
 (Contract NASw-2163)
 (NASA-CR-125815; TRW-17683-6001-RO-00-App) Avail: NTIS CSCL 08C

Tables and graphs are presented for a review of oceanographic studies using satellite-borne instruments. The topics considered include sensor requirements, error analysis for wind determination from glitter pattern measurements, coverage frequency plots, ground station rise and set times, a technique for reduction and analysis of ocean spectral data, rationale for the selection of a 2 PM descending orbit, and a priority analysis. K.P.D.

N72-23292 Bureau of Commercial Fisheries, Galveston, Tex. Biological Lab.
OCEANOGRAPHIC DATA REQUIREMENTS FOR THE DEVELOPMENT OF AN OPERATIONAL SATELLITE SYSTEM
 Robert E. Stevenson In Princeton Univ. Proc. of the Princeton Univ. Conf. on Aerospace Method for Revealing and Evaluating Earth's Resources Jun. 1970 12 p refs

Copyright. Avail: Issuing Activity

Oceanographic data requirements for manned, orbital space systems in conjunction with surface exploration are described. Earth orbital sensor systems are needed to measure ocean color; sea-surface roughness; sea-surface temperature; slope of ocean surface and of significant waves; atmospheric profiles of temperature, moisture, and carbon dioxide; and lunar magnitude of tide-producing forces. Information available from Apollo photographs is illustrated, and it is felt that because of uncertainties of rates and magnitudes of change in ocean waters, the experimental space program requires man's discrimination in missions coupled with simultaneous oceanographic cruises. The major ocean areas with sites for prime surveys and calibration tests are listed. It is felt that technology exists for the development and implementation of earth resource satellite systems. N.E.N.

N72-23327* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NIMBUS OBSERVATION OF OCEANIC UPWELLING
 Karl-Heinz Szekieda In its Significant Accomplishments in Sci., 1970 1972 p 14-17 Original contains color illustrations

Avail: NTIS HC \$3.00 CSCL 08C

Observing the development of upwelling on the northeast coast of Africa by measuring ocean surface emission with infrared radiometers on Nimbus satellites is reported. Using the temperature of the ocean as telemetered by the satellite, the biological potential of an area is estimated, and consequently the highest potential for fisheries. F.O.S.

N72-23328* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MICROWAVE EMISSION OF ARCTIC SEA ICE
 Per Gloersen In its Significant Accomplishments in Sci., 1970 1972 p 18-21

Avail: NTIS HC \$3.00 CSCL 08L

The feasibility of carrying microwave radiometers on Nimbus E and F missions for sea ice surveys was studied in the arctic using aircraft. It was found that passive microwave signatures of Arctic Sea ice relate specifically to the structure and type of ice. It is concluded that a new tool for conducting ice surveys from aircraft and satellites with remote sensors was discovered.

F.O.S.

N72-23329* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MICROWAVE MEASUREMENTS OF SEA STATE
 Thomas Wilheit In its Significant Accomplishments in Sci., 1970 1972 p 22-27
 Avail: NTIS HC \$3.00 CSCL 08C

Passive microwave measurements were studied for determining sea state. It was found that the brightness temperature increases due to the foam produced by winds, and that the surface wind can be determined by the brightness temperature. F.O.S.

N72-23330* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AIR-SEA INTERACTION IN THE PACIFIC OCEAN
 Lewis J. Allison In its Significant Accomplishments in Sci., 1970 1972 p 28-31
 Avail: NTIS HC \$3.00 CSCL 08C

Daily Tiros and ESSA satellite television nephelometry over the Pacific Ocean were collected, and monthly cloud charts drawn to study the interaction of tropical oceans with the atmosphere. The data were correlated with climatological data for rainfall and surface temperatures. F.O.S.

N72-23416* Naval Oceanographic Office, Washington, D.C. Special Publication, Nov. 1969 - Mar. 1970.
REPORT OF THE ANTARCTIC ICE OBSERVING AND FORECASTING PROGRAM, 1969
 Rudolph J. Perchal Oct. 1971 128 p
 (AD-737410; N00-SP-80(69)) Avail: NTIS CSCL 08/12

The sea ice program conducted by the U. S. Naval Oceanographic Office principally in support of DEEP FREEZE 70 antarctic operations is presented. Methods of data collection and dissemination, ice forecasting, ice advisories and allied ice projects are discussed. Ice conditions observed by aerial reconnaissance in the Ross Sea and McMurdo Sound from November 1969 to February 1970 are summarized. Ice conditions interpreted from satellite data generally by 1- to 4-day periods are also presented. Author (GRA)

N72-23448* Woods Hole Oceanographic Institution, Mass.
USE OF VISIBLE REGION SENSORS FOR OCEAN DATA ACQUISITION FROM SPACEBORNE AND AIRBORNE PLATFORMS Final Report
 George L. Clarke and Gifford C. Ewing Dec. 1971 121 p refs
 (Contract N62306-70-C-0343)
 (AD-736189; WHOI-Ref-71-71) Avail: NTIS CSCL 08/10

An investigation was carried out for measuring ocean color from the air, for correlating it was the physical and biological conditions of the sea, and for interpreting the data obtained. The feasibility of distinguishing between ocean areas containing low and moderate chlorophyll concentrations from flight altitudes up to 10,000 feet is shown experimentally by means of an airborne spectrophotometer. For inter-comparison of data obtained under a wide variety of conditions, a computer system to maintain and manipulate files of airborne oceanographic data stored on magnetic tape is generated and described. Author (GRA)

05 OCEANOGRAPHY AND MARINE RESOURCES

N72-25334*# Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.

OCEANOGRAPHIC SCANNER SYSTEM DESIGN STUDY, VOLUME 1

Oct. 1971 413 p refs

(Contract NASw-2119)

(NASA-CR-126721; BSR-3129-Vol-1) Avail: NTIS HC \$22.75 CSCL 08J

The design is reported of a dual mode multispectral scanner, capable of satisfying both overland and oceanographic requirements. A complete system description and performance summary of the scanner are given. In addition, subsystem and component descriptions and performance analyses are treated in individual sections. The design of the scanner, with minimum modifications, interfaces to the ERTS spacecraft and the ground data handling system. D.L.G.

N72-25335*# Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.

OCEANOGRAPHIC SCANNER SYSTEM DESIGN STUDY, VOLUME 2

Oct. 1971 49 p

(Contract NASw-2119)

(NASA-CR-126722; BSR-3129-Vol-2) Avail: NTIS HC \$4.50 CSCL 08J

Breadboard tests of the scanner system were conducted and the results obtained are described. The findings reported include those from tests on the optics system, scan mechanism hardware, and the electronics system. In addition, various alternative configurations are discussed and the alignment tolerances are analyzed. D.L.G.

N72-25405# Texas A&M Univ., College Station. Remote Sensing Center.

PLANNING AND IMPLEMENTATION OF REMOTE SENSING EXPERIMENTS Final Report, Sep. 1970 - Sep. 1971

George L. Huebner, Jr. Nov. 1971 133 p refs

(Contract N62306-71-C-0029; A/M Proj. 756)

(AD-737348; RSC-756-1) Avail: NTIS CSCL 08/10

Contents: TEKITE II experiment-upwelling detection (NASA Mx 138); Design of oceanographic experiments (Gulf of Mexico, Mx 159); Design of oceanographic experiments (Gulf of Mexico, Mx 165); Experiments on thermal pollution; Remote sensing newsletter; Symposium on remote sensing in marine biology and fishery resources. GRA

N72-25806# National Environmental Satellite Center, Washington, D.C.

SATELLITE ACTIVITIES OF NOAA 1971

Apr. 1972 15 p

Avail: NTIS HC \$3.00

Ocean and weather observations by satellites, and supporting activities by research laboratories and data processing facilities are presented for 1971. N.E.N.

N72-26272*# National Aeronautics and Space Administration, Washington, D.C.

REMOTE SENSING OF THE CHESAPEAKE BAY

1972 176 p refs Conf. held at Wallops Station, Va., 5-7 Apr. 1971 Original Contains Color Illustrations

(NASA-SP-294; LC-74-190299) Avail: NTIS SOD \$2.25 CSCL 08J

The proceedings of a conference on remote sensing of the Chesapeake Bay are presented. Primary emphasis was placed on the application of specific remote sensing techniques to determine various aspects of the ecology of the area. Subjects discussed are: (1) environmental pollution from industrial wastes, air pollution,

and agricultural sedimentation and wastes, (2) environmental balance as related to estuarine turbidity, flushing, salinity, and circulation, (3) natural resources, (4) recreational uses, and (5) economic activity.

N72-26278*# Maryland Univ., College Park.

REMOTE SENSING AND EXTRACTABLE BIOLOGICAL RESOURCES

c04

L. Eugene Cronin / In NASA, Washington Remote Sensing of the Chesapeake Bay 1972 p 83-89 refs

Avail: NTIS; SOD \$2.25 CSCL 08A

The nature and quantity of extractable biological resources available in the Chesapeake Bay are discussed. The application of miniaturized radio sensors to track the movement of fish and birds is described. The specific uses of remote sensors for detecting and mapping areas of algae, red tide, thermal pollution, and vegetation beds are presented. The necessity for obtaining information on the physical, chemical, and meteorological features of the entire bay in order to provide improved resources management is emphasized.

Author

N72-26281*# Virginia Inst. of Marine Science, Gloucester Point.

ENGINEERING WORKS AND THE TIDAL CHESAPEAKE

William J. Hargis, Jr. / In NASA, Washington Remote Sensing of the Chesapeake Bay 1972 p 105-123 refs

Avail: NTIS; SOD \$2.25 CSCL 08J

The tidal tributaries of the ocean and coastal areas of the mid-Atlantic region and the ecological significance of engineering projects are discussed. The effects of engineering works on maritime environments and resources, with the Chesapeake Bay as the area of prime interest are examined. Significant engineering projects, both actual and proposed, are described. The conflict of navigational demands and maintenance of an estuarine environment for commercial and sport fishing and recreation is described. Specific applications of remote sensors for analyzing ecological conditions of the bay are included.

Author

N72-26282*# Maryland Dept. of Chesapeake Bay Affairs, Annapolis.

USE OF REMOTE SENSING IN SHORELINE AND NEAR SHORE MANAGEMENT

John R. Capper / In NASA, Washington Remote Sensing of the Chesapeake Bay 1972 p 125-127

Avail: NTIS; SOD \$2.25 CSCL 08J

The legal aspects of resources management to regulate near-shore and shoreline area activities in the Chesapeake Bay are discussed. The need for information and acquisition in order to define the resources prior to developing legislation on resources management is explained. The steps which are followed in devising the regulatory legislation and enforcing its provisions are outlined.

Author

N72-26284*# Corps of Engineers, Baltimore, Md.

CHESAPEAKE BAY STUDY

William J. Love / In NASA, Washington Remote Sensing of the Chesapeake Bay 1972 p 139-142

Avail: NTIS; SOD \$2.25 CSCL 08J

The objectives and scope of the Chesapeake Bay study are discussed. The physical, chemical, biological, political, and social phenomena of concern to the Chesapeake Bay area are included in the study. The construction of a model of the bay which will provide a means of accurately studying the interaction of the ecological factors is described. The application of the study by management organizations for development, enhancement, conservation, preservation, and restoration of the resources is examined.

Author

N72-26285* Johns Hopkins Univ., Baltimore, Md.

SUMMARIES OF GROUP DISCUSSIONS

Loren D. Jensen / In NASA, Washington Remote Sensing of the Chesapeake Bay 1972 p 143-144
 Avail: NTIS; SOD \$2.25 CSCL 13B

Group discussions following the presentations of reports on the remote sensing of Chesapeake Bay resources are presented. The parameters to be investigated by the remote sensors and the specifications of the sensors are described. Specific sensors for obtaining data on various aspects of the ecology are identified. Recommendations for establishing a data bank and additional efforts to obtain increased understanding of the ecology are submitted. P.N.F.

N72-27170* Scientific Translation Service, Santa Barbara, Calif.

RELATIONSHIP BETWEEN OUTGOING MICROWAVE RADIATION AND THE SURFACE OF THE SEA (BASED ON DATA OBTAINED FROM THE KOSMOS-243 SATELLITE
 L. M. Martsinkevich and D. T. Matveyev Washington NASA May 1972 19 p refs Transl. into ENGLISH from Meteorol. Gidrol. (USSR), no. 8, 1971 p 50-59
 (Contract NASw-2035)

(NASA-TT-F-14400) Avail: NTIS HC \$3.00 CSCL 17B

A combined analysis of data on radiometric satellite wind waves is performed. It is demonstrated that a relationship exists between the brightness temperature and the sea-surface state. This relationship serves as a basis for using radiometric information with the aim of finding storm zones in oceans. Author

N72-27362* National Oceanic and Atmospheric Administration, Washington, D.C.

SOME PRELIMINARY RESULTS OF 1971 AIRCRAFT MICROWAVE MEASUREMENTS OF ICE IN THE BEAUFORT SEA

Richard J. DeRycke and Alan E. Strong Jun. 1972 11 p refs (NOAA-TM-NESS-37) Avail: NTIS HC \$3.00

Passive microwave data in the 2.8-cm (10.69 GHz) wavelength region were acquired from a NASA aircraft during the 1971 Arctic ice dynamics joint experiment. Comparison of data obtained on a cloud-free day and on a day with a complete cloud cover beneath the aircraft demonstrated that the relative age of sea ice may be observed and mapped adequately by microwave sensing from satellite altitudes regardless of cloud cover. Author

N72-28158* Ohio State Univ., Columbus. Dept. of Electrical Engineering.

A THEORETICAL STUDY OF RADAR RETURN AND RADIOMETRIC EMISSION FROM THE SEA

William H. Peake Washington NASA Jul. 1972 11 p refs

(Contract NAS1-9998)

(NASA-CR-2092; Rept-3030-2) Avail: NTIS HC \$3.00 CSCL 17I

The applicability of the various electromagnetic models of scattering from the ocean are reviewed. These models include the small perturbation method, the geometric optics solution, the composite model, and the exact integral equation solution. The restrictions on the electromagnetic models are discussed. Author

N72-28312* Atlantic Oceanographic and Meteorological Labs., Miami, Fla.

REMOTE SENSING OF OCEAN CURRENTS Bimonthly Report, 4 May - 4 Jul, 1972

George A. Maul, principal investigator 1 Aug. 1972 8 p Sponsored by NASA

(E72-10004; NASA-CR-127555; GSFC-ID-CO315;

ERTS-A-Proposal-108) Avail: NTIS HC \$3.00 CSCL 08C

This report contains no significant results.

Author

N72-28403* Tiburon Marine Lab., Bureau of Sport Fisheries and Wildlife, Calif.

MEASUREMENTS OF SEA SURFACE TEMPERATURE ON THE EASTERN PACIFIC CONTINENTAL SHELF USING AIRBORNE INFRARED RADIOMETRY Oceanographic Report, Aug. 1963 - Jul. 1968

James L. Squire, Jr. Dec. 1971 237 p refs

(PB-208156; USCG373-47; Oceanog-47) Avail: NTIS HC \$3.00 CSCL 08J

Airborne surveys were conducted monthly from August 1963 through July 1968, using an infrared radiometer to measure sea surface temperatures and to develop isotherm charts depicting temperature ranges for three areas of the eastern Pacific Continental Shelf. A total of 179 airborne surveys were conducted from aircraft. Sea surface temperatures determined by the monthly surveys are presented in contoured charts. Five-year mean sea surface temperatures for each of the three survey areas were determined for each calendar month of the year by 10-minute longitude by 10-minute latitude areas and isotherm charts were drawn from these data. Author (GRA)

N72-28430* Sandia Labs., Livermore, Calif.

AN AIR DROPPED SEA ICE PENETROMETER

C. W. Young and L. J. Keck Dec. 1971 96 p refs

(MIPR Z-70099-0-02552)

(AD-739991; SC-DR-71-0729) Avail: NTIS CSCL 08/12

An air dropped penetrometer has been developed for the U.S. Coast Guard to remotely measure the thickness of sea ice. The development program is described, and the test data and results of the Arctic test program are presented and discussed. The sea ice thickness in the vicinity of Thule Air Base, Greenland, and Alert, Canada, was measured by the penetrometers with an accuracy of plus or minus 3 inches (plus or minus 7.6 cm) during the April 1971 tests. Author (GRA)

N72-28431* New York Univ., N.Y. Dept. of Meteorology and Oceanography.

RADAR SATELLITE OCEANOGRAPHY AND OCEAN DYNAMICS Final Report, 1 Jul. 1970 - 1 Dec. 1971

Willard J. Pierson and Vincent Cardone Dec. 1971 96 p

(Contract N62306-70-A-0075)

(AD-739385) Avail: NTIS CSCL 08/3

The document contains reports on remote sensing of ocean surfaces by satellite radar radiometry. GRA

N72-29275* National Environmental Satellite Service, Washington, D.C.

EVALUATION OF ERTS DATA FOR CERTAIN OCEANOGRAPHIC USES Progress Report, Apr. - Jul. 1972

Alan E. Strong, Principal Investigator 2 Aug. 1972 2 p

(NASA Order S-70246-AG)

(E72-10023; NASA-CR-127747; BMPR-1) Avail: NTIS HC \$3.00 CSCL 08J

There are no author-identified significant results in this report.

N72-29300* McGill Univ., Montreal (Quebec). Arctic Meteorology Research Group.

EVALUATION OF NORTH WATER SPRING ICE COVER FROM SATELLITE PHOTOGRAPHS

P. G. Aber and E. Vowinckel Jun. 1971 25 p refs

(Contract DRBC-9511-107)

(Publ-101) Avail: NTIS HC \$3.25

Satellite photographs for two years (March - September) have been used to study ice cover in the polynya called North Water in Canada, and to determine whether reliable ice maps can be made from satellite data without computer analysis. After early July the clouds become opaque and distinction between cloud and ice was impossible. It was concluded that ice distribution for short periods can best be obtained by careful human photointerpretation. The most persistent open water is

05 OCEANOGRAPHY AND MARINE RESOURCES

found at the northern edge, at about 78 N. The southern ice edge is diffuse. Author

N72-29309* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

MICROWAVE EMISSION MEASUREMENTS OF SEA SURFACE ROUGHNESS, SOIL MOISTURE, AND SEA ICE STRUCTURE c14

P. Gloersen, T. Wilheit, and T. Schmugge *In its 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 19 p refs*
Original contains color illustrations

CSSL 14B

In order to demonstrate the feasibility of the microwave radiometers to be carried aboard the Nimbus 5 and 6 satellites and proposed for one of the earth observatory satellites, remote measurements of microwave radiation at wavelengths ranging from 0.8 to 21 cm have been made of a variety of the earth's surfaces from the NASA CV-990 A/C. Brightness temperatures of sea water surfaces of varying roughness, of terrain with varying soil moisture, and of sea ice of varying structure were observed. In each case, around truth information was available for correlation with the microwave brightness temperature. The utility of passive microwave radiometry in determining ocean surface wind speeds, at least for values higher than 7 meters/second has been demonstrated. In addition, it was shown that radiometric signatures can be used to determine soil moisture in unvegetated terrain to within five percentage points by weight. Finally, it was demonstrated that first year thick, multi-year, and first year thin sea ice can be distinguished by observing their differing microwave emissivities at various wavelengths. Author

N72-29310* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

RADIOMETRIC OCEAN COLOR SURVEYS THROUGH A SCATTERING ATMOSPHERE

Robert J. Curran and Warren A. Hovis *In its 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 12 p refs*

CSSL 08J

A series of aircraft flights has been initiated to measure the spectral reflectance of ocean waters containing various concentrations of chlorophyll. The results of both the theoretical and experimental investigations indicate that satellite-borne radiometers can sense ocean color. However, the accuracy to which the chlorophyll concentration can be measured appears to be 0.1 to 0.4 mg/cu m depending upon solar zenith angles. These accuracies are less than desired by many of the oceanographers and an effort is being made to improve the quality of the chlorophyll concentration determination. Further measurements will be made in areas with higher chlorophyll concentration in order to better understand the relationship between chlorophyll concentration and ocean color. Also the effects of high water turbidity will be investigated. A.L.

N72-29311* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A MULTISPECTRAL METHOD OF MEASURING SEA SURFACE TEMPERATURES FROM SATELLITES

William E. Shenk and Vincent V. Salomonson *In its 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 14 p refs*

CSSL 08J

A multispectral technique has been developed which independently tests for the presence of clouds before a registered window radiance measurement is accepted as coming from the sea surface and the intervening atmosphere. The spatial resolution of ocean temperature mapping can be the same as that of the radiometer. With the 55 km subsatellite track resolution of the Nimbus 2 MRIR, current boundaries and upwelling areas have been successfully identified. Knowledge of the position of these

regions and temperatures within them are important to the detection of areas of high chlorophyll concentrations. Author

N72-29313* National Aeronautics and Space Administration. Mississippi Test Facility, Bay Saint Louis.

SUMMARY OF 1971 WATER REMOTE SENSING INVESTIGATIONS

Edward Lee Tilton, III *In its 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 12 p*

CSSL 08J

The Earth Resources Laboratory sea remote sensing program has concentrated on project planning, data acquisition procedures, and data preparation techniques to establish a firm procedural basis for the program. Most of these procedural elements were established and proven during the three missions conducted in 1971. It is anticipated that the program in 1972 will see the analysis completed on the Mississippi Sound series and the first series of Eastern Gulf experiments allowing increased emphasis to be given to more intensive technique development studies, the interrelationship of parameters for the measurement and prediction of water circulation, and the demonstration of the application of these techniques. Author

N72-29314* National Aeronautics and Space Administration. Mississippi Test Facility, Bay Saint Louis.

MISSISSIPPI SOUND REMOTE SENSING STUDY

B. Houston Atwell and G. C. Thomann *In its 4th Ann. Resources Program Rev., Vol. 1 21 Jan. 1972 28 p*

CSSL 08J

Remote sensing techniques are being developed to study near shore marine waters in the Mississippi Sound. Specific elements of the investigation include: (1) evaluation of existing techniques and instrument capabilities for remote measurement of parameters which characterize near shore water; (2) integration of these parameters into a system which will make possible the definition of circulation characteristics; (3) conduct of applications experiments; and (4) definition of hardware development requirements and/or system specifications. Efforts have emphasized: (1) development of a satisfactory system of gathering ground truth over the entire area of Mississippi Sound to aid in evaluating remotely sensed data; (2) conduct of two data acquisition experiments; (3) analysis of individual sensor data from completed flights; and (4) pursuit of methods which will allow interrelations between data from individual sensors in order to add another dimension to the study. Author

N72-29320* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EARTH RESOURCES PROGRAMS AT THE LANGLEY RESEARCH CENTER. PART 2: COASTAL ZONE OCEANOGRAPHY PROGRAM

Walter E. Bressette *In its 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 24 p* Original contains color illustrations

CSSL 08J

The approaches used to develop the coastal zone oceanic research program are outlined, and activities in the areas of satellite application, estuaries, continental shelf and environmental modeling are briefly described. Author

N72-29325* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

MICROWAVE BRIGHTNESS TEMPERATURE OF A WINDBLOWN SEA

Forrest G. Hall *In its 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 22 p refs*

CSSL 08J

A mathematical model is developed for the apparent

temperature of the sea at all microwave frequencies. The model is a numerical model in which both the clear water structure and white water are accounted for as a function of wind speed. The model produces results similar to Stogryn's model at 19.35 GHz for wind speeds less than 8 m/sec; it can use radiosonde data to calculate atmospheric effects and can incorporate an empirically determined antenna gain pattern. The corresponding computer program is of modular design and the logic of the main program is capable of treating a horizontally inhomogeneous surface or atmosphere. It is shown that a variation of microwave brightness temperature with zenith angle is necessary to produce the wind sensitivity of the horizontally polarized brightness temperature; the variation of sky temperature with frequency is sufficient to produce a frequency dependent wind sensitivity. Author

N72-29379* National Oceanic and Atmospheric Administration, Washington, D.C.

MICROWAVE CHARACTERISTICS OF THE OCEAN SURFACE IN THE 1-10 GHz BAND

Alan E. Strong and Ronald A. Porter (Radiometric Technol. Inc., Wakefield, Mass.) *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 19 p refs

CSCCL 08C

The microwave characteristics of calm, rough, and foam-covered ocean surfaces were studied, and a technique was developed for deriving thermodynamic ocean surface temperatures from brightness temperatures measured by an earth-orbiting radiometer. This investigation encompassed frequencies in the range 1 to 10 GHz (wavelength range of 30 to 3 cm) and was based on the use of a one-dimensional geometrical optics roughness model, including shadowing and multiple scattering of radiant electromagnetic energy. Provision is made in the model for characterizing surface roughness through the rms slope versus wind velocity relations previously established. Suitable foam and atmospheric models were superimposed on the roughness model. Author

N72-29380* National Oceanic and Atmospheric Administration, Miami, Fla. Sea-Air Interaction Lab.

OBSERVATIONS OF OCEANIC WHITE CAPS FOR MODERATE TO HIGHWIND SPEEDS

Duncan B. Ross and Vincent Cardone (New York Univ., N. Y.) *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 20 p refs Original contains color illustrations

CSCCL 08C

A series of photographs of sea surface whitecap conditions for wind speeds of 10 to 25 m/sec was obtained and analyzed for areal coverage of white water. The results are in good agreement with semiempirical calculations based on the wind speed and the development of the wave spectrum only when the contribution of thin foam streaks oriented in the direction of the wind is neglected. Since both the actively forming whitecaps and the thin foam streaks contribute significantly to the microwave emissivity of the sea surface, it is important that the foam streaks be included in the theory but differentiated from large white caps and foam patches. A simple relationship that accounts for the foam streaks based on the rate of energy transfer, the wind speed, and the wave spectrum is proposed. By means of empirically derived constant terms for the microwave signatures of white caps and foam streaks, this theory was adapted to the prediction of the increase in brightness temperature due to foam, with reasonable results to wind speeds of 20 m/sec. Author

N72-29381* National Oceanic and Atmospheric Administration, Washington, D.C.

THE CONSTRAINT OF SUN GLINT ON VISIBLE DATA GATHERED BY EARTH SATELLITES

Alan E. Strong *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 13 p refs

CSCCL 03B

Sunglint simulation for the ocean surface is considered for selected satellite orbits in an attempt to optimize the selection of an orbit suitable for ocean color measurements. It appears that ocean color sensing by satellite may be most productive during a near-noon polar orbit. Author

N72-29382* National Oceanic and Atmospheric Administration, Washington, D.C.

SPECIAL DISPLAYS OF SATELLITE INFRARED DATA FOR SEA ICE MONITORING

E. Paul McClain *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 11 p refs

CSCCL 08L

The NOAA ITOS environmental satellites and their data processing systems are discussed. Sea ice surveillance by satellite and infrared data are considered. K.P.D.

N72-29383* Allied Research Associates, Inc., Concord, Mass. **APPLICATION OF SATELLITE INFRARED MEASUREMENTS TO MAPPING SEA ICE**

James C. Barnes *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 6 p

CSCCL 08L

The application of the ITOS-SR (scanning radiometer) infrared measurements for mapping sea-ice was examined. The work included detailed mapping of ice features visible in the ITOS nighttime DRSR (direct readout scanning radiometer) pictorial data and in Nimbus summertime film strip data. Analyses of digital temperature values from computer printouts of ITOS stored data and from Nimbus data listings were also undertaken, and densitometric measurements of both ITOS and Nimbus data were initiated. Author

N72-29384* Aerojet-General Corp., El Monte, Calif. Microwave Div.

MICROWAVE EMISSION CHARACTERISTICS OF SEA ICE

A. T. Edgerton and G. Poe *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 22 p refs Sponsored by NOAA

CSCCL 08L

A general classification is presented for sea ice brightness temperatures with categories of high and low emission, corresponding to young and weathered sea ice, respectively. A sea ice emission model was developed which allows variations of ice salinity and temperature in directions perpendicular to the ice surface. Author

N72-29385* National Oceanic and Atmospheric Administration, Washington, D.C.

REGIONAL STUDIES USING SEA SURFACE TEMPERATURE FIELDS DERIVED FROM SATELLITE INFRARED MEASUREMENTS

Alan E. Strong *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 14 p refs

CSCCL 08C

Three examples of sea surface temperature distributions over the western Atlantic are presented. These were detected by means of data from the scanning radiometer on the Improved Tiros Operational Satellite 1 (ITOS 1) under relatively clear sky conditions. Author

05 OCEANOGRAPHY AND MARINE RESOURCES

N72-29386* National Marine Fisheries Service, Bay Saint Louis, Miss.

FISHERIES RESOURCE IDENTIFICATION AND ASSESSMENT STUDIES

William H. Stevenson *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 8 p refs

CSSL 08A

Program coordination activities were shifted from the Space Oceanography Program of NAVOCEANO to the National Environmental Satellite Service as part of NOAA in October 1970. Program activities in remote sensing continued in the development of low-light-level image intensifiers, spectrometers, aerial photography, and lasers for the location, identification, and quantification of living marine resources at or near the sea surface. Other studies included the development of a biologically controlled impoundment for remote sensor investigations and limited activities in fish oil film research. In addition to these remote sensing studies, the National Marine Fisheries Service (NMFS) program at the Mississippi Test Facility is participating in space oceanography studies related to fisheries and in the ERTS-A and Skylab experiments. Aspects of the NMFS program related to fisheries resource identification and assessment during the period 1970 and 1971 are discussed. Author

N72-29392* New York Univ., N.Y.

THE EXTRAPOLATION OF LABORATORY AND AIRCRAFT RADAR SEA RETURN DATA TO SPACECRAFT ALTITUDES

Willard J. Pierson and Richard K. Moore (Kansas Univ.) *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 47 p refs

(Contract N62306-70-A-0075-0007)

CSSL 08C

Laboratory measurements show that the spectra of capillary waves grow with wind speed over six orders of magnitude. The scatter in the data can be partially understood and predicted from a combination of turbulence theory, radar theory, and the small sample theory of statistical inference. When these results are applied to a prediction of the sea return values to be obtained by S193 on Skylab, it can be shown that the size of the illuminated patch effectively averages out the horizontal scales of gustiness, so that the measurement will correspond to the synoptic scale wind. Author

N72-29393* Naval Research Lab., Washington, D.C. E. O. Hulburt Center for Space Research.

MISSION 119 PASSIVE MICROWAVE RESULTS

J. P. Hollinger and R. A. Mennella *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 11 p refs

CSSL 08C

Passive microwave measurements of the sea surface were made for determining surface wind speeds from the NP3A aircraft (NASA-927). Observations were made at frequencies of 1.4, 10.6, and 31.4 GHz during NASA mission 119, undertaken off Bermuda in the vicinity of Argus Island sea tower during January 1970. Passive microwave observations from Argus Island ocean showed that the surface roughness effect, dependent on wind speed, is also dependent on observational frequency, increasing with increasing frequency. The roughness effect appears to be dominant for wind speeds less than 30 to 40 knots (2). Author

N72-29394* Scripps Institution of Oceanography, La Jolla, Calif.

APPLICATION OF THERMAL RADIATION DATA TO FISHERY OCEANOGRAPHY

Merritt Stevenson and Forrest Miller *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 18 p refs

CSSL 08A

Work on Project Little Window-1 and -2. DRIR data conversion, improvements on the APT receiver, equatorial upwelling, and the topic of thermal fronts is discussed. Author

N72-29395* Naval Research Lab., Washington, D.C.

THE CASE FOR OCEAN COLOR

Henry J. Yotko *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 5 p refs

CSSL 08C

The concept of monitoring the plankton-producing areas of the world is discussed in relation to assessing the exchange of CO₂/O₂ on a world-wide basis as a part of a life-support system. Author

N72-29396* Scripps Institution of Oceanography, San Diego, Calif. Visibility Lab.

DETECTION OF OCEAN CHLOROPHYLL FROM EARTH ORBIT

Seibert O. Duntley *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 25 p refs

CSSL 08A

Calculations were made of the magnitude of the optical signature of ocean chlorophyll available to any remote sensor in earth orbit. It was desired to ascertain whether commercially significant concentrations of chlorophyll-A pigments in the ocean would produce a sufficient optical signal at orbital altitudes to operate optical remote sensors, such as those planned for the earth observatory satellite, on clear and hazy days. It was also desired to explore the effect of solar altitude on these optical signals. The best orientation was desired for the field of view for a remote sensor in orbit in order to optimize its ability to detect ocean chlorophyll. Author

N72-29397* TRW Systems Group, Redondo Beach, Calif.

A TECHNIQUE FOR THE REDUCTION AND ANALYSIS OF OCEAN SPECTRAL DATA

Peter G. White *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 10 p ref

CSSL 08C

Some initial investigations of a method of reducing and analyzing raw ocean spectral data are presented. The method avoids most problems associated with atmospheric effects, and requires the application of little, if any, calibration information to the data. Author

N72-29398* Oregon State Univ., Corvallis. Oceanography Dept.

REMOTE MEASUREMENT OF CHLOROPHYLL CONCENTRATION AND SECCHI-DEPTH USING THE PRINCIPAL COMPONENTS OF THE OCEAN'S COLOR SPECTRUM

James L. Mueller *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 13 p refs

(Contract N62306-70-C-041)

CSSL 08A

Statistical results and conclusions are presented, based on direct comparisons of the ocean's color and chlorophyll concentration. The ocean color and ground truth data for this analysis were collected during Mission 140 of NASA's NP3A earth resources aircraft over the period from 6 through 14 August 1970. During this experiment, chlorophyll and light attenuation data were collected. All sets of comparative observations are simultaneous in the sense that the ship began sampling when the aircraft came overhead. Author

N72-29399* Scripps Institution of Oceanography, San Diego, Calif. Visibility Lab.

SURFACE TRUTH MEASUREMENTS OF OPTICAL PROPERTIES OF THE WATERS IN THE NORTHERN GULF OF CALIFORNIA

Roswell W. Austin /In NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 21 p refs
CSCL 08C

Gemini and Apollo flight photographs of the southwestern United States and northwestern Mexico, and especially of the Colorado River delta and the northwestern Gulf of California, are considered. The clearly discernible water coloration in the imagery led to the suggestion that remote sensing techniques may be usefully applied in such areas to determine bathymetric information. Measurements of the optical properties of the water in this region obtained in March 1971 showed that generally low transmissivities prevailed and at no station did the beam transmittance for the total water column exceed 2.5×10 to the -8th power. It was concluded that any correlation between water depth and spectral radiance at the surface must result from secondarily related phenomena. Author

N72-29400* International Imaging Systems, Mountain View, Calif.

PRACTICAL UTILITY OF THE BLUE SPECTRAL REGION

Donald S. Ross /In NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 29 p refs Original contains color illustrations

CSCL 14E

Some aspects of multispectral photography in the blue region are discussed briefly, and sample images are submitted to demonstrate the potential utility of the blue multispectral record for oceanography. Author

N72-29401* National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.

EVALUATION OF FACTORS AFFECTING RESOLUTION OF SHALLOW WATER BOTTOM FEATURES

Curtis C. Mason, Dean R. Norris, and I. Dale Browne /In its 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 14 p refs Original contains color illustrations

CSCL 08C

To ensure good aerial photography, the effects that factors such as submergence depth, sun angle, film and filter type, exposure, aircraft altitude, and polarization have on the photographic resolution of an underwater object must be determined. Various subjects were photographed, such as the deck of a small submersible, colored and gray scale panels, and natural bottom features. No underwater resolution target was used. Author

N72-29402* Michigan Univ., Ann Arbor.

MULTISPECTRAL OBSERVATIONS OF MARINE ENVIRONMENTS

Fabian C. Polcyn /In NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 23 p refs
CSCL 08C

It is demonstrated that the multispectral scanner, using multiple channels in registry and recorded on magnetic tape, can be used in variety of applications in the marine environment. Author

N72-29403* Long Island Univ., Greenvale, N.Y. Science Engineering Research Group.

COASTAL AND ESTUARINE APPLICATIONS OF MULTI-SPECTRAL PHOTOGRAPHY

Edward Yost and Sondra Wenderoth /In NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 17 p refs Original contains color

illustrations

CSCL 14E

An evaluation of multispectral photographic techniques for optical penetration of water in the northeastern United States, and the Gulf of Mexico coastal waters is presented. The spectral band (493 to 543 nanom), when exposed to place the water mass at about unit density on the photographic emulsion, was found to provide the best water penetration, independent of altitude or time of day, as long as solar glitter from the surface of the water is avoided. An isoluminous color technique was perfected, which eliminates the dimension of brightness from a multispectral color presentation. Author

N72-29405* Naval Research Lab., Washington, D.C.

THE TONGUE OF THE OCEAN AS A REMOTE SENSING OCEAN COLOR CALIBRATION RANGE

Leo V. Strees /In NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 13 p refs Original contains color illustrations

CSCL 08C

In general, terrestrial scenes remain stable in content from both temporal and spacial considerations. Ocean scenes, on the other hand, are constantly changing in content and position. The solar energy that enters the ocean waters undergoes a process of scattering and selective spectral absorption. Ocean scenes are thus characterized as low level radiance with the major portion of the energy in the blue region of the spectrum. Terrestrial scenes are typically of high level radiance with their spectral energies concentrated in the green-red regions of the visible spectrum. It appears that for the evaluation and calibration of ocean color remote sensing instrumentation, an ocean area whose optical ocean and atmospheric properties are known and remain seasonably stable over extended time periods is needed. The Tongue of the Ocean, a major submarine channel in the Bahama Banks, is one ocean area for which a large data base of oceanographic information and a limited amount of ocean optical data are available. Author

N72-29406* National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.

A PROGRAM TO ASSESS A THERMAL DISCHARGE ON TRINITY BAY, TEXAS

James B. Zaitzeff (Naval Res. Lab.) and Victor S. Whitehead /In its 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jul. 1972 2 p

CSCL 08H

The application of a two dimensional mathematical model to the analysis of the thermal discharge to verify its ability to predict the temperature distribution of Trinity Bay in the vicinity of the water outfall. Basic data consist of aerial thermal infrared and in situ measurements. Author

N72-29451# TRW Systems Group, Redondo Beach, Calif. Theoretical Physics Group.

ANALYTICAL STUDIES OF SCATTERING AND EMISSION BY THE SEA SURFACE Final Report, 1 Mar. 1971

1 Mar. 1972

Richard J. Wagner and Philip J. Lynch Mar. 1972 72 p refs (Contract N00014-71-C-0240; NR Proj. 387-051)

(AD-740237; TRW-17608-6006-RO-00) Avail: NTIS CSCL 08/3

Geometrical optics theories of scattering, transmission, and emission of electromagnetic radiation from two-dimensional, anisotropic, randomly rough surfaces have been formulated which explicitly include the effects of surface shadowing and double scatter. These theoretical developments, which have been fully documented in technical reports issued on this contract, are herein summarized in abstract form. Application of the emission and scattering theories to the modeling of sea brightness temperatures is discussed. The equations for the sea brightness temperature are numerically evaluated for microwave frequencies and the results compared with those of earlier models of Stogryn and of Wagner and Lynch. The second-order contributions, which prove to be appreciable, are examined in detail as a

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function of surface roughness, observation direction, and polarization. The quantitative dependence of the sea brightness temperature on frequency, polarization, observation angle, wind speed, fetch direction, atmospheric state, surface contamination, and water temperature is illustrated. The wavelength dependence of the emissivity of small-scale surface structure is examined using nongeometrical optics methods. Author (GRA)

N72-30314*# Geological Survey, Menlo Park, Calif.
STUDIES OF INNER SHELF AND COASTAL SEDIMENTATION ENVIRONMENT OF THE BEAUFORT SEA FROM ERTS-A Bimonthly Report
Erk Reimnitz, Principal Investigator and Peter Barnes 17 Jul. 1972 1 p Sponsored by NASA
(E72-10034; NASA-CR-127899) Avail: NTIS HC \$3.00 CSCI 08J

There are no author-identified significant results in this report.

N72-30319# Texas A&M Univ., College Station.
PROCEEDINGS OF THE SYMPOSIUM ON REMOTE SENSING IN MARINE BIOLOGY AND FISHERY RESOURCES
Mar. 1971 305 p refs Symp. held at College Station, Tex. Sponsored by the Food and Agr. Org. and Intergovernmental Oceanog. Comm. and NSF
(TAMU-SG-71-106) Avail: NTIS; Office of Sea Grant Program, Texas A&M Univ., College Station, Tex. 77843: \$4.00

The objectives of this conference were two-fold: (1) to bring together the investigators active in the utilization of remote sensing in marine biology and fisheries; and (2) to provide for discussions leading to improved harvest and management of these resources.

N72-30320 National Marine Fisheries Service, Bay Saint Louis, Miss.
REMOTE SENSING IN THE NATIONAL MARINE FISHERIES SERVICE

W. H. Stevenson /In Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 1-7

The NMFS seeks to discover, describe, develop, and conserve the living resources of the global sea, especially as these affect the American economy and diet. The objective of the program is recruit new tools to locate, survey, and monitor living marine resources, and to facilitate the incorporation of these tools into ongoing survey and harvesting procedures. The tools under consideration are spectrophotometers, low light level image intensifiers, lasers, acoustic imaging, micro-infrared detectors, and photography. The remote sensing program is organized into three components: management, evaluation, and operations. The duties and responsibilities of these three groups are briefly described. A.L.

N72-30321 Earth Satellite Corp., Washington, D.C.
OPERATIONAL USE OF REMOTE SENSORS IN COMMERCIAL FISHING
Paul M. Maughan and Allan D. Marmelstein /In Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 8-24 refs

The history of the development of aerial fish spotting is reviewed and some examples of its use in commercial fishing operations such as catching menhaden are described. The future use of remote sensors in resource management is considered. Briefly discussed is a system incorporating a low light level sensor, a Doppler laser, and a computer for harvesting menhaden at night. A.L.

N72-30322 Ocean Protein, Inc., Lafayette, La. Zapata Remote Sensing Div.

SOME POTENTIAL APPLICATIONS OF REMOTE SENSING IN FISHERIES

Kirby L. Drennan /In Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 25-65 refs Sponsored by Naval Oceanographic Office

Present techniques utilized by industry and Government to locate harvestable fish stocks and survey the resources of large oceanic areas, are inadequate. Remote sensing from aerospace platforms appears to offer a more effective and economical means for assessing present resources and providing the information needed to predict the future abundance and distribution of fishery resources. A number of significant characteristics of fish and their environment, which may be observed through the use of remote sensors, are presented. Those sensors which have been shown to have potential application as well as the environmental factors which contribute to and limit their usefulness, are also discussed. Author

N72-30323 Woods Hole Oceanographic Institution, Mass.
REMOTE SPECTROGRAPHY OF OCEAN COLOR AS AN INDEX OF BIOLOGICAL ACTIVITY

Gifford C. Ewing /In Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 66-74 refs

Over 3,000 ocean spectra of sunlight backscattered from the upper layers of the sea have been obtained at flight altitudes to 10,000 feet together with detailed ground truth. The backscattered light in each part of the visible spectrum has been calculated as a percentage of the incident downwelling irradiance at the sea surface. The spectrum thus obtained reveals the action of the water itself and of materials suspended and dissolved in the water. The relationship between light extinction and biological productivity has been studied. Certain important materials have recognizable spectral signatures; thus the shape of the spectrum can be used to measure the kinds and amounts of substances present. Although the shape of the spectra changed characteristically with altitudes, the differences between members of each pair and their contrast ratio remained nearly the same and clearly showed the location of the transition. Author

N72-30324 Massachusetts Univ., Gloucester.
THE ABSORPTION AND FLUORESCENCE CHARACTERISTICS OF BIOCHEMICAL SUBSTANCES IN NATURAL WATERS

Charles S. Yentsch /In Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 75-97 ref
(Contract AT(30-1)-4241; Grant NSF GA-27082)

The major factors known to selectively transmit or remove wavelengths of visible light in ocean water are reviewed. The prime substances affecting light absorption and fluorescence and what environmental factors alter their distribution and abundance are discussed. Problems where remote sensing would be invaluable are suggested. Author

N72-30325 Barringer Research Ltd., Rexdale (Ontario).
THE REMOTE SENSING OF VAPORS OF MARINE ORGANIC ORIGIN

A. J. Moffat and A. R. Barringer /In Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 98-126 refs

Three types of remote sensing of vapors are possible, one of which is suitable for use from high altitude aircraft and spacecraft and the other two from low altitude aircraft and ships. In the case of high altitude remote sensing, optical methods can be employed in vertical incidence for detecting spectral characteristics of emitted or reflected optical radiation. Experiments have been carried out with a technique known as correlation spectroscopy in which incoming radiation in the

visible spectrum has been matched in real time against a stored replica of the iodine spectrum in order to monitor the vertical burden of free iodine over the ocean. Iodine is considered to be of interest as a potential indicator of biological productivity and region of primary fish food. Greater sensitivity can be achieved, however, with these techniques used in horizontal scanning modes from low flying aircraft, ships and truck-mounted monitors on the coastline. There has been some evidence that increased concentrations of free iodine vapor can be measured over plankton areas using the latter technique. Theoretical calculations indicate that instruments can be optimized for iodine detection to provide adequate sensitivity for satellite monitoring. Author

N72-30326 Baird-Atomic, Inc., Bedford, Mass.
REMOTE SENSING OF MARINE AND FISHERIES RESOURCES BY FLOURESCENCE METHODS

A. W. Hornig /in Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 127-157 Sponsored by Naval Oceanographic Office

Many materials of importance to marine and fisheries resources fluoresce with sufficient efficiency to be detectable at reasonable aircraft altitudes when excited at night with existing light sources. Further, the specificity of the excitation and emission spectra is great enough to allow discrimination between many materials. Arc or laser stimulated fluorescence promises to provide a new and useful method for remote sensing which supplements multispectral and color photography. Author

N72-30327 Oregon State Univ., Corvallis Dept. of Oceanography.

REMOTE SENSING AND THE PELAGIC FISHERIES ENVIRONMENT OFF OREGON

William G. Pearcy /in Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 158-171 refs

(Contract N622308-70-C-0414; NSF GH-45)

These investigations were undertaken during 1969 and 1970 to: (1) learn more about the ocean conditions off Oregon during the summer and how they effect the albacore tuna catches and the productivity of the pelagic food chain; and (2) provide albacore fishermen with information in near real time that could be used in scouting for fish. The research constituted a broad and multidisciplinary program, and included four interdependent components: (1) remote sensing aircraft; (2) oceanographic vessels; (3) commercial albacore boats; and (4) albacore advisory service. Remote sensing aircraft used infrared radiometers, multispectral scanners, ocean color spectrometer, L-band microwave radiometer, and multispectral photography. Results to date are all preliminary. The catch data from both 1969 and 1970 are still being processed. The data obtained from the multispectral scanner, the spectrometer, and microwave are on tape and are being analyzed. Author

N72-30330 Michigan Univ., Ann Arbor.
APPLICATIONS OF MULTISPECTRAL SENSING TO MARINE RESOURCES SURVEYS

Fabian C. Polcyn /in Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 194-217 refs

Applications of the multispectral scanner technique to various aspects of the marine environment are described. Covered are: (1) mapping of aquatic vegetation; (2) the feasibility of remotely measuring water depth; (3) the study of thermal effluents and associated water mass movements; (4) the detection of industrial discharges; and (5) the mapping of large oil slicks near shore while differentiating the oil from some of the aquatic vegetation such as kelp that occurs in certain areas. Author

N72-30332 Virginia Univ., Charlottesville.
STUDIES OF BENTHIC COVER IN NEAR SHORE TEMPERATE WATERS USING AERIAL PHOTOGRAPHY

Mahlon G. Kelly /in Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 227-248 refs
 (Contract N62308-70-A-0073-0003)
 (Tr-0008)

This research was undertaken to: (1) determine the feasibility of using aerial photography to study the distribution of benthic cover in turbid Long Island; (2) to find the best type of photography for that purpose; (3) to describe and map as much of the benthic cover as possible; (4) to examine what may be deduced from the patterns of distribution; and (5) to compare these patterns with those previously studied in the much clearer waters of South Florida. The ultimate goal is to obtain a better understanding of factors determining the distributional patterns of shallow benthic cover. The films, cameras, altitudes flown, and results are described in detail. Author

N72-30333 Intergovernmental Oceanographic Commission, Paris (France).

AN APPLICATION OF THE THEORY OF GAMES TOWARD IMPROVING THE EFFICIENCY OF CERTAIN PELAGIC FISHING OPERATIONS

Saul B. Sella /in Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 249-265 refs

The problem of how a fishing vessel should allocate search effort in order to make the probability of encounter and capture of a fish shoal as high as possible under specific conditions is briefly considered. The rational allocation of available search time as suggested in this report involved no additional expense for equipment. It merely involves some relatively simple calculations. Tentative conclusions include: (1) The fishing vessel must be relatively close to the coordinates of the initial sighting in order to make the probability of success high enough to justify search effort. (2) Any additional information on the direction and/or velocity of the fish shoal reduces the difficulty of the search problem and increases the probability of success greatly. (3) If the remote sensing device can only report position coordinates, then further behavioral and other biological information is clearly needed. Author

N72-30335 National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

UPWELLING STUDIES WITH SATELLITES

Karl-Heinz Szekieda /in Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 271-293 refs

Two different ways of obtaining surface temperature structures with data from an orbiting platform are: (1) Analysis of radiometric recordings during one overpass over apparently cloud-free regions has provided the surface structures of an area. This method can be used to analyze a synoptic recording and has the further advantage of noting rapid changes in the sea surface temperatures over typical scales of a few days. (2) Mapping the sea surface temperature through use of a multispectral method which detects cloud-free conditions and uses the radiation for the determination of the sea surface temperature. This method includes data recorded from orbiting platforms over a period of 2 to 4 weeks; therefore, short-time fluctuations are smoothed out. The method is applicable to map ocean surfaces on a global scale. Both methods were used to study areas in oceans where upwelling exists. Author

N72-30348* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

MICROWAVE SIGNATURES OF FIRST-YEAR AND MULTIYEAR SEA ICE

P. Gloersen, P. Nordberg, T. J. Schmugge, T. T. Wilheit, and W. J. Campbell (Geological Survey) Aug. 1972 22 p refs
 Submitted for publication Original contains color illustrations
 (NASA-TM-X-66008; X-652-72-312) Avail: NTIS HC \$3.25 CSCI 08L

A combination of remote sensing from an aircraft and

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simultaneous surface measurements have confirmed the feasibility of identifying old and new sea ice according to its emission of thermal radiation at wavelengths between 0.3 and 3 cm. Emissivity of first-year thick ice with a surface temperature of about 260 K is 0.95 or greater for wavelengths between 0.81 and 11 cm; the emissivity of multiyear ice is 0.8 at 0.81 cm and 0.95 at 11 cm, increasing monotonically in this wave length interval. The ease with which multiyear ice can be distinguished from first-year ice using a passive microwave radiometer is demonstrated by comparing mosaics prepared both from photographs and images of 1.55 cm radiation. Author

N72-30570# World Meteorological Organization, Geneva (Switzerland).

EXPERIMENT DESIGN PROPOSAL FOR THE GARP ATLANTIC TROPICAL EXPERIMENT Global atmospheric research programme

Jun. 1972 199 p refs Prepared jointly with Intern. Council of Sci. Unions

(GATE-1) Avail: NTIS HC \$12.00

The design and implementation of the GARP Atlantic Tropical Experiment (GATE) is presented, together with the general scientific objectives and the global implications of the experiment. The program and other research activities are considered and some aspects (cloud clusters, tropical waves, tropical convection) are examined in detail. The observational strategy and network is described and general information on the data management, communication systems, support facilities, and functional structure is given. A bibliography is included.

ESRO

N72-31334*# Corps of Engineers, Washington, D.C. Coastal Engineering Research Center.

COASTAL APPLICATIONS OF THE ERTS-1 SATELLITE IMAGERY

Orville T. Magoon, Principal Investigator 29 Sep. 1972 17 p Presented as Preliminary Findings from Analyses of ERTS Observations, NASA Goddard Space Flight Center, Greenbelt, Md., 29 Sep. 1972

(NASA Order S-70257AG)

(E72-10043; NASA-CR-128123) Avail: NTIS HC \$3.00 CSDL 08H

There are no author-identified significant results in this report. Samples are given of the possible applications of ERTS-1 imagery to coastal and nearshore studies. Briefly discussed are: (1) obtaining regional views of extended coastal areas; (2) distribution of sediments; (3) coastal configurations and changes; (4) barrier islands; (5) underwater penetration, and (6) coastal waves. A.L.

N72-31335*# Long Island Univ., Greenvale, N.Y.

A STUDY OF THE ESTUARINE AND COASTAL OCEANOGRAPHY OF BLOCK ISLAND SOUND AND ADJACENT NEW YORK COASTAL WATERS

Edward Yost, Principal Investigator 29 Sep. 1972 4 p Presented as Preliminary Findings from Analyses of ERTS Observations, NASA Goddard Space Flight Center, Greenbelt, Md., 29 Sep. 1972

(Contract NAS5-21799)

(E72-10044; NASA-CR-128124) Avail: NTIS HC \$3.00 CSDL 08H

There are no author-identified significant results in this report. ERTS-1 imagery was received from NASA in both positive and negative form. This imagery was analyzed to determine the hydrologic features of the water mass, including current patterns, particulate in suspension, and the contacts between different water masses, as well as coastal marsh characteristics. A Spectral Data Model 84 multispectral projector/viewer was used for the analysis. Quick look analysis of the second generation negatives indicated that: (1) green spectral band lacked contrast and was overexposed; (2) red spectral had acceptable contrast, but somewhat overexposed; and (3) infrared bands overexposed for land areas, but exposure

good for water. Analysis of second generation positives indicated that: (1) green spectral band extremely flat; (2) red spectral band of acceptable contrast, but too dense for projection; and (3) infrared bands lacked detail in both water and land areas. Photographs indicate that it is necessary to expose and process the multispectral imagery for the scene brightness range under consideration. A.L.

N72-31338*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

CHLOROPHYLL STRUCTURE IN THE OCEAN

Karl Heinz Szekielda, Principal Investigator and Robert J. Curran 29 Sep. 1972 2 p refs Presented as Preliminary Findings from Analyses of ERTS Observations, NASA Goddard Space Flight Center, Greenbelt, Md. 29 Sep. 1972 Prepared in cooperation with Delaware Univ.

(Contract NAS5-21784)

(E72-10047; NASA-TM-X-68605) Avail: NTIS HC \$3.00 CSDL 08A

There are no author-identified significant results in this report.

N72-31345*# National Oceanic and Atmospheric Administration, Washington, D.C.

DETECTION OF ICE CONDITIONS IN THE QUEEN ELIZABETH ISLANDS

E. Paul McClain 29 Sep. 1972 1 p Presented as Preliminary Findings from Analyses of ERTS Observations, NASA Goddard Space Flight Center, Greenbelt, Md., 29 Sep. 1972 Sponsored by NASA

(E72-10054; NASA-CR-128056) Avail: NTIS HC \$3.00 CSDL 08L

There are no author-identified significant results in this report.

N72-31346*# Geological Survey, Tacoma, Wash.

ANALYSIS OF ARCTIC ICE FEATURES

William I. Campbell and E. Paul McClain 29 Sep. 1972 2 p Presented as Preliminary Findings from Analyses of ERTS Observations, NASA Goddard Space Flight Center, Greenbelt, Md., 29 Sep. 1972 Sponsored by NASA

(E72-10055; NASA-CR-128057) Avail: NTIS HC \$3.00 CSDL 08L

There are no author-identified significant results in this report.

N72-31352*# National Oceanic and Atmospheric Administration, Miami, Fla.

REMOTE SENSING OF OCEAN CURRENTS Bimonthly Report, 4 Jul. - 4 Sep. 1972

George A. Maul, Principal Investigator 8 Sep. 1972 7 p Sponsored by NASA

(E72-10068; NASA-CR-128083) Avail: NTIS HC \$3.00 CSDL 08C

There are no author-identified significant results in this report.

N72-31363*# Arizona Univ., Tucson. Dept of Biological Sciences.

STUDY OF THE MARINE ENVIRONMENT OF THE NORTHERN GULF OF CALIFORNIA Progress Report, period ending 31 Jul. 1972

J. R. Hendrickson, Principal Investigator 31 Jul. 1972 4 p

(Contract NAS5-21777)

(E72-10083; NASA-CR-128098) Avail: NTIS HC \$3.00 CSDL 08J

There are no author-identified significant results in this report.

N72-31408# Inter-American Tropical Tuna Commission, La Jolla, Calif.

APPLICATION OF HIGH RESOLUTION INFRARED AND VISUAL DATA TO INVESTIGATE CHANGES IN AND THE RELATIONSHIP BETWEEN SEA SURFACE TEMPERATURES AND CLOUD PATTERNS OVER THE EASTERN TROPICAL PACIFIC Final Report

Merritt R. Stevenson and Forrest R. Miller Apr. 1972 93 p refs

(Contract N62306-71-C-0120)

(AD-743114) Avail: NTIS CSCL 08/10

Results on the application of infrared data from NASA and NOAA satellites for use in the field of fishery oceanography are given. Preliminary results of Project Little Window 2 (LW-2) held in the Gulf of California are discussed. A general review of the numerical techniques used for handling infrared data is given. Methods for photo-digitization of 70 mm and 35 mm filmstrips are also described and examples are given. The importance of surface thermal fronts to biota in general and to the tuna fishery in particular, in the eastern tropical Pacific is discussed. Selected numerical techniques for producing charts that emphasize gradient features are described and examples are given.

Author (GRA)

N72-31413# TRW Systems Group, Redondo Beach, Calif. Theoretical Physics Group.

ANALYTICAL STUDIES OF SCATTERING AND EMISSION BY THE SEA SURFACE Quarterly Status Report, 1 Mar. - 31 May 1972

Richard J. Wagner 1 Jun. 1972 3 p

(Contract N00014-71-C-0240; NR Proj. 387-051)

(AD-743147; TRW-17608-6008-RO-00) Avail: NTIS CSCL 08/3

An appropriate form of the sea surface wave height spectrum is discussed. GFA

N72-31449# Communications Research Centre, Ottawa (Ontario).

THEORY AND FIELD TESTS OF A UHF RADIOMETER FOR DETERMINING SEA ICE THICKNESS

A. W. Adey, T. R. Hartz, R. E. Barrington, W. Rolfe, and W. E. Mather Jan. 1972 17 p refs Presented at the Symp. on Remote Sensing and Earth Resource Satellites, Toronto, 15-16 Mar. 1971

(CRC-TN-637) Avail: NTIS HC \$3.00

A theoretical analysis of the UHF emissions from sea ice and/or sea water is outlined. This work indicates that a radiometer system designed to observe these emissions could be used to determine the thickness of sea ice. To explore this possibility, a radiometer operating at frequencies from 400 MHz to 2.3 GHz was designed and built. The results of initial ground-based and airborne tests of this instrument are presented. Comparisons are made between the field observations and the theory.

Author

N72-32335*# Geological Survey, Menlo Park, Calif.

STUDIES OF THE INNER SHELF AND COASTAL SEDIMENTATION ENVIRONMENT OF THE BEAUFORT SEA FROM ERTS-1 Progress Report, 1 Jul. - 31 Aug. 1972

Erk Reimnitz, Principal Investigator 1 Sep. 1972 5 p Sponsored by NASA

(E72-10062; NASA-CR-128136) Avail: NTIS HC \$3.00 CSCL 08J

The author has identified the following significant results. Field studies of the initiation of river flow onto the frozen Arctic Ocean were made by a group of scientists from May 15 to June 10, 1972. A time lapse camera mounted on a 40-ft. tower near the mouth of the Kaparuk River, west of Prudhoe Bay, provided a detailed 10-day record (24 hours a day) of flow direction and water level. It is believed that wind build-up, discharge variance

of the river, and through-ice drainage rates are the prime factors influencing overflow onto the sea ice. Current meter, transmissometer, temperature, salinity, and thermoprobe data were collected from holes drilled in the shorefast ice from seal holes and from the river water overflow. Depth and a real distribution of the overflow water were monitored from the ice using snowmobiles, and from the air using helicopters and fixed-wing aircraft. Photographic records were made on 35mm KII, KX, Ektachrome IR, Plus X, and IR black and white film. A simple two camera frame permitted simultaneous exposures of two types of film. Preliminary comparisons of the IR and conventional films, both color and black and white, showed no advantage to using the infrared film. However, the low altitude photography taken during this study will be very helpful in the interpretation of ERTS-1 imagery.

N72-32369*# Delaware Univ., Newark. Coll. of Marine Studies.

APPLICABILITY OF ERTS-1 SATELLITE IMAGERY TO THE STUDY OF COASTAL PROCESSES

V. Klemas, Principal Investigator 4 Oct. 1972 3 p Sponsored by NASA

(E72-10119; NASA-CR-128168) Avail: NTIS HC \$3.00 CSCL 08H

There are no author-identified significant results in this report.

N72-32380*# Alaska Univ., College.

CIRCULATION OF PRINCE WILLIAM SOUND Bimonthly Progress Report

Robin D. Muench, Principal Investigator 30 Sep. 1972 2 p Sponsored by NASA

(E72-10132; NASA-CR-128186; BMPR-1) Avail: NTIS HC \$3.00 CSCL 08H

There are no author-identified significant results in this report.

N72-32381*# Alaska Univ., College.

SEA, ICE AND SURFACE WATER CIRCULATION, ALASKAN CONTINENTAL SHELF Bimonthly Progress Report

Frederick F. Wright, Principal Investigator and G. D. Sharma 30 Sep. 1972 2 p Sponsored by NASA

(E72-10133; NASA-CR-128187; BMPR-1) Avail: NTIS HC \$3.00 CSCL 08H

There are no author-identified significant results in this report.

N72-32389*# Delaware Univ., Newark. Coll. of Marine Studies.

APPLICATION OF ECOLOGICAL, GEOLOGICAL AND OCEANOGRAPHIC ERTS-1 IMAGERY TO DELAWARE'S COASTAL RESOURCES PLANNING Progress Report, Sep. - Oct. 1972

V. Klemas, Principal Investigator 18 Oct. 1972 10 p Sponsored by NASA

(E72-10142; NASA-CR-128211) Avail: NTIS HC \$3.00 CSCL 08A

The author has identified the following significant events. Coastal vegetation species appearing in the ERTS-1 image taken of the Southern Coast of Delaware, during orbit 333 on August 16, 1972, have been correlated with ground truth vegetation maps, and imagery obtained from high altitude RB-57 and U-2 overflights. The vegetation maps of the entire Delaware Coast were prepared using data collected on foot, in small boats, and from low altitude aircraft. Multispectral analysis of high altitude RB-57 and U-2 photographs indicated that five vegetation species could be clearly discriminated from 60,000 feet altitude, including: (1) salt marsh cord grass (*Spartina alterniflora*); (2) salt marsh hay and spike grass (*Spartina patens* and *Distichlis*

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spicata); (3) reed grass (*Phragmites communis*); (4) high tide bush and sea myrtle (*Iva* species and *Baccharus halimifolia*); and (5) a group of fresh water species found in impounded areas built to attract water fowl. Major *Spartina alterniflora* and *Spartina patens* communities within the tidal marshes can be identified in the ERTS-1 imagery. *Phragmites*, and other species however, occur in smaller, more dispersed groupings and are difficult to discriminate within the resolution capability of the ERTS-1 scanner. Similarly, major impounded areas, built to attract water fowl can be detected; however, mosquito drainage ditches, covering many of Delaware's marshes, are too narrow and not long enough to be resolved by ERTS-1 sensors. High-marsh and dune communities dominated by high tide bush (*Iva frutescens*) and sea myrtle (*Baccharus halimifolia*) can be distinguished from adjacent maritime forest and beach grass communities.

N72-32418*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ESTIMATION OF SEA SURFACE TEMPERATURE FROM REMOTE MEASUREMENTS IN THE 11-13 MICRON WINDOW REGION

C. Prabhakara, B. J. Conrath, and V. G. Kunde Oct. 1972 17 p refs
(NASA-TM-X-66053; X-651-72-358) Avail: NTIS HC \$3.00 CSCL 08C

The Nimbus-4 IRIS data was examined in the spectral region 775 to 1250/cm (8-13 microns) for useful information to determine the sea surface temperature. The high spectral resolution data of IRIS was degraded to low resolution by averaging to simulate a multi-channel radiometer in the window region. These simulated data show that within the region 775-975/cm (12.9-10.25 microns) the brightness temperatures are linearly related to the absorption parameters. Such a linear relationship is observed over cloudy as well as clear regions and over a wide range of latitudes. From this linear relationship it is feasible to correct for the atmospheric attenuation and get the sea surface temperature, accurate to within 1 K, in a cloud free field of view. The information about the cloud cover is taken from the TV pictures and BUV albedo measurements on board the Nimbus-4 satellite. Author

N72-32425# Coast Guard, Washington, D.C. ICEBERG CLASSIFICATION USING SIDE LOOKING AIRBORNE RADAR

L. D. Farmer May 1972 44 p
(CG Proj. 726414)
(AD-742653) Avail: NTIS CSCL 08/12

The Coast Guard has been experimenting with a Side Looking Airborne Radar for use in radar target classification by the International Ice Patrol. The report, which was prepared for the International Ice Patrol, outlines the classification clues and techniques that appear valid at this time for classifying targets as either ice or other than ice. In addition, the report contains information on mensuration, mission planning and radar malfunctions to enhance its value as a training aid.

Author (GRA)

N72-33310*# Earth Satellite Corp., Washington, D.C.
INVESTIGATION TO IMPROVE MENHADEN FISHERY AND PREDICTION Progress Report, 1 Aug. - 31 Oct. 1972
Paul M. Maughan, Principal Investigator 20 Oct. 1972 4 p
(Contract NAS5-21743)
(E72-10152; NASA-CR-128288) Avail: NTIS HC \$3.00 CSCL 08A

There are no author-identified significant results in this report.

N72-33314*# National Oceanic and Atmospheric Administration, Miami, Fla.

OCEANOGRAPHIC OBSERVATION OF NEW YORK BIGHT FROM ERTS-1

George A. Maul, Principal Investigator and Robert L. Charnell 13 Oct. 1972 11 p refs Original contains illustrations. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
(NASA Order S-70246-AG)
(E72-10156; NASA-CR-128292) Avail: NTIS HC \$3.00 CSCL 08C

The author has identified the following significant events. The Earth Resources Technology Satellite made a transit over New York Bight on 16 August, 1972. Imagery from this transit shows several oceanographic features that demonstrate the usefulness of remote sensing for large area, synoptic observation of changes in water quality in the coastal zone. Both the extent and turbulent character of the Hudson River plume are discernible in the image. Residue from a dump of waste acid is visible over a five mile area in the apex of the Bight. Little dispersion of this residue has occurred which suggests that this feature will be a persistent signature in images from future satellite transits.

N72-33324# Oregon State Univ., Corvallis.
AIRPHOTO ANALYSIS OF OCEAN OUTFALL DISPERSION
Fred J. Burgess and Wesley P. James Jun. 1971 298 p refs
Sponsored by the Environmental Protection Agency. Its Water Pollution Control Res. Series no. 16070 ENS
Avail: SOD \$2.25

Aerial photography was taken of the ocean outfall waste plume at Newport, Oregon, during the summers of 1968, 1969, and the period extending from September 1970 through May 1971. Conventional boat sampling of the waste field was conducted concurrently with the photography during the 1968 and 1969 field seasons. The photographic technique is more comprehensive and permits waste concentrations to be measured throughout the plume in one instant. Procedures were developed to evaluate proposed ocean outfall sites by using dye drops from an airplane. Diffusion coefficients and water current velocities were determined from aerial photography. When the hydrography of the receiving water allowed the formation of a surface plume, the water current velocity was found to be the dominant factor in the resulting plume pattern. The equation for a line source in a uniform stream provided the x and y velocity components for a two-dimensional diffusion model with the losses to the lower layers being considered by including a decay coefficient. Author

N72-33351# Clemson Univ., S.C. Dept. of Civil Engineering.
A STATE OF THE ART SURVEY OF THE APPLICATIONS OF AERIAL REMOTE SENSING TO COASTAL ENGINEERING
Donald B. Stafford May 1972 193 p
(Contract DACW72-70-C-0034)
(AD-744479) Avail: NTIS CSCL 08/6

The report presents the results of a comprehensive survey of the applications of aerial remote sensing techniques in the field of coastal engineering. Part 1 presents a narrative summary of the state of the art of coastal engineering applications of aerial remote sensors. Existing and potential applications of the techniques are described. Important characteristics of the various aerial remote sensors and the limitations of the techniques in coastal engineering applications are discussed. The primary aerial remote sensors considered are black and white, black and white infrared, color, and color infrared aerial photographs, satellite photographs, infrared imagery, multispectral imagery, and radar imagery. Part 2 is an annotated bibliography describing the coastal engineering applications of aerial remote sensing techniques. This is a representative compilation of literature written over the past 30 years. A variety of coastal engineering applications of aerial remote sensors are described. Approximately 200 references are listed in the annotated bibliography. Author (GRA)

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N72-33783* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ARCTIC ICE MEASUREMENTS WITH MICROWAVE RADIOMETERS
 Per Gloersen *In its Significant Accomplishments in Sci.*, 1971 Jun. 1972 p 13-18
 CSCL 08L

N72-33784* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A MULTISPECTRAL METHOD OF DETERMINING SEA SURFACE TEMPERATURES
 William E. Shenk *In its Significant Accomplishments in Sci.*, 1971 Jun. 1972 p 19-23

CSCL 08J

N72-33785* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MEASUREMENTS OF OCEAN COLOR
 Warren A. Hovis *In its Significant Accomplishments in Sci.*, 1971 Jun. 1972 p 24-29

CSCL 08J

N73-10350*# Corps of Engineers, Vicksburg, Miss. Waterways Experiment Station.
SEDIMENT PATTERN CORRELATIONS WITH INFLOW AND TIDAL ACTION Progress Report, 1 Aug. - 30 Sep. 1972
 Warren E. Grabau, Principal Investigator 19 Oct. 1972 3 p
 Sponsored by NASA
 (E72-10169; NASA-CR-128360) Avail: NTIS HC \$3.00 CSCL 08H

N73-10352*# Long Island Univ., Greenvale, N.Y. Science Engineering Research Group.
AN INTERDISCIPLINARY STUDY OF THE ESTUARINE AND COASTAL OCEANOGRAPHY OF BLOCK ISLAND SOUND AND ADJACENT NEW YORK COASTAL WATERS Progress Report, period ending 15 Oct. 1971
 Edward Yost, Principal Investigator 20 Oct. 1972 2 p
 (Contract NAS5-21792)
 (E72-10171; NASA-CR-128362) Avail: NTIS HC \$3.00 CSCL 08H

N73-10353*# Long Island Univ., Greenvale, N.Y. Science Engineering Research Group.
AN INTERDISCIPLINARY STUDY OF THE ESTUARINE AND COASTAL OCEANOGRAPHY OF BLOCK ISLAND SOUND AND ADJACENT NEW YORK COASTAL WATERS Progress Report, period ending 15 Aug. 1972
 Edward Yost, Principal Investigator 17 Aug. 1972 1 p
 (Contract NAS5-21792)
 (E72-10172; NASA-CR-128363) Avail: NTIS HC \$3.00 CSCL 08H

N73-10369*# International Imaging Systems, Mountain View, Calif.
PROPOSAL FOR OCEAN WATER COLOR ASSESSMENT FROM ERTS-A RBV AND MSS IMAGERY Progress Report, period ending 7 Nov. 1972
 Donald S. Ross, Principal Investigator 7 Nov. 1972 3 p
 Sponsored by NASA
 (E72-10190; NASA-CR-128388) Avail: NTIS HC \$3.00 CSCL 08J

N73-10375*# Delaware Univ., Newark.
DYNAMICS OF PLANKTON POPULATIONS IN UPWELLING AREAS. CHLOROPHYLL MEASUREMENTS IN UPWELLING AREAS BY REMOTE SENSING (CURS) Progress Report, Jun. - Aug. 1972
 Karl-Heinz Szekizlda, Principal Investigator Sep. 1972 11 p
 (Contract NAS5-21784)
 (E72-10196; NASA-CR-128440) Avail: NTIS HC \$3.00 CSCL 08A

N73-10421# California Univ., Riverside. Dept. of Geography.
COASTAL STUDIES IN BAJA CALIFORNIA
 John A. Minch, Virginia Coleman, Jack B. Bale, Harold F. Gilman, and Douglas B. McDonald Jun. 1972 112 p refs
 (Contract N00014-69-A-0200-5003)
 (AD-744310; TR-O-72-1; TR-O-72-5; TR-O-72-2; TR-O-72-3; TR-O-72-4) Avail: NTIS CSCL 08/6

In June, 1970 Rodman Snead made a field study of particular rock types in the San Felipe area of Baja California. Later that summer at a remote sensing institute at the University of California, Riverside, Douglas McDonald and Rodman Snead had an opportunity to study three different types of aerial photographs taken over the San Felipe region. The three types of photographs were medium altitude black and white vertical photographs, low altitude color infrared oblique photographs, and Apollo IX space photography. The purpose of this paper is to mention the landforms observed on the ground which can be easily viewed on these photographs and to discuss the advantages and disadvantages of using each of the three types. Author (GRA)

N73-10424# Rhode Island Univ., Kingston. Dept. of Geology.
COASTAL GEOLOGY BIBLIOGRAPHY OF NEW ENGLAND: A PUNCH CARD SYSTEM Final Report
 John J. Fisher May 1972 131 p refs
 (Contract DACW72-70-C-0019)
 (AD-744001) Avail: NTIS CSCL 08/7

The bibliography is a cross-referenced index of coastal geologic studies of the New England coastal region. A marginal punch card bibliographic system devised for this project is discussed, and operational advantages for such a system for coastal reference studies of this type are outlined. Similar coastal geologic bibliographies both regional and topical in nature, are also reviewed. 750 references for the New England States are cross-indexed as to location and the following coastal geologic subjects: beaches, marine biology, changes of sea level, coasts, coastal engineering geology, offshore coastal geology, ecology, eolian sands, geology of coastal areas, sedimentation and waves, currents and tides.
 Author (GRA)

N73-11297*# Environmental Research and Technology, Inc., Lexington, Mass.
EVALUATE THE APPLICATION OF ERTS-A DATA FOR DETECTING AND MAPPING SEA ICE Bimonthly Progress Report, 31 Aug. - 31 Oct. 1972
 James C. Barnes, Principal Investigator 10 Nov. 1972 12 p
 (Contract NAS5-21802)
 (E72-10199; NASA-CR-129065; ERT-P-408-2) Avail: NTIS HC \$3.00 CSCL 08L

N73-11306*# Ecole Pratique des Hautes Etudes, Paris (France).
THE FRALIT TELEDETECTION PROGRAM, USING THE ERTS-A SATELLITE, FOR THE OCEANIC LITTORAL OF FRANCE [LE PROGRAM FRALIT TELEDETECTION, PAR LE SATELLITE ERTS-A, DU LITTORAL OCEANIQUE DE LA FRANCE]
 F. Verger, Principal Investigator, Ch. Cazabat, P. Demathieu, and J. Dupuis [1972] 10 p refs In FRENCH Sponsored by NASA
 (E72-10211; NASA-CR-128482) Avail: NTIS HC \$3.00 CSCL

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08J

There are no author-identified significant results in this report. The French Atlantic Littoral program, utilizing data from the ERTS-1 satellite, is considered. It involves teledetection of the French shoreline along the Atlantic Ocean and English Channel. A description is given of the ERTS-1 orbit and the satellite itself, including the attitude control system, and the data acquisition and transmission equipment. The geographic extent of the area covered by the program is delineated and the subjects studied are enumerated. These include the geomorphology, pedology, hydrology, and vegetation of the maritime marshes; sedimentology, morphology, and hydrology of the intertidal zones; and transport of material in suspension to the mouths of the Seine, the Loire, and the Gironde as a part of the coastal waters study. Transl. by K.P.D.

N73-11309*# National Marine Fisheries Service, Bay Saint Louis, Miss.

APPLICATION OF ERTS-1 FOR FISHERY RESOURCE ASSESSMENT AND HARVEST

William H. Stevenson, Paul M. Maughan, Principal Investigators (Earth Satellite Corp., Washington, D. C.), and Buddy H. Atwell [1972] 8 p
(Contract NAS5-21743; NASA Order S-70246-AG)
(E72-10215; NASA-CR-128486) Avail: NTIS HC \$3.00 CSCL 08A

N73-11318*# National Environmental Satellite Service, Washington, D.C.

EVALUATION OF ERTS DATA FOR CERTAIN OCEANOGRAPHIC USES Semiannual Report, Apr. - Sep. 1972

Alan E. Strong, Principal Investigator Sep. 1972 4 p refs
(NASA Order S-70246-AG)
(E72-10224; NASA-CR-129157) Avail: NTIS HC \$3.00 CSCL 08C

N73-11326*# National Oceanic and Atmospheric Administration, Miami, Fla. Atlantic Oceanographic and Meteorological Labs.

REMOTE SENSING OF OCEAN CURRENTS Interim Report, May. - Nov. 1972

George A. Maul, Principal Investigator Nov. 1972 8 p
(NASA Order S-70246-AG)
(E72-10233; NASA-CR-129107) Avail: NTIS HC \$3.00 CSCL 08C

The author has identified the following significant results. Monthly field experiments in support of the NOAA investigation of ocean color boundary determination using ERTS data have been conducted since June 1972. The color boundary between the Loop Current and coastal water has been detected by airborne cameras with ERTS type bandpass filters, at altitudes of 7300 meters. Ship and aircraft data hint that the boundary may be enhanced due to increased phytoplankton populations caused by convergence of the surface waters. The term edge effect has been coined to describe this phenomenon.

N73-11370# Plessey Environmental Systems, San Diego, Calif.

STUDY TO DETERMINE THE IMPLICATIONS OF REMOTE SENSING DATA ON US FISHING TECHNOLOGY: TROPICAL TUNA AND ALASKA SALMON Final Report, 1971-1972

Robert P. Brown, Edward H. Shenton, Gordon Broadhead, Frank Alverson, and Charles Peckham Jun. 1972 195 p refs Prepared in cooperation with Living Marine Resources, Inc., San Diego, Calif.

(Contract N62306-71-C-0012)
(AD-745774) Avail: NTIS CSCL 05/3

A study was conducted during 1971 and 1972 to determine ways in which remotely sensed data from spacecraft and aircraft could be used to assist fishery technology in tropical tuna and Alaska salmon fisheries. The project assessed the operational

characteristics of each of these fisheries including the history, biology, vessels and gear, search and catch methods, economics, and research and regulatory aspects. A similar assessment was made of the state-of-the-art of remote sensors with application to fishery oceanography. A series of field verification visits were made to each fishery and for remote sensing. Author (GRA)

N73-12348*# Geological Survey, Menlo Park, Calif.

STUDIES OF THE INNER SHELF AND COASTAL SEDIMENTATION ENVIRONMENT OF THE BEAUFORT SEA FROM ERTS-A Progress Report, 1 Sep. - 31 Oct. 1972

Erk Reimnitz, Principal Investigator and Peter W. Barnes 31 Oct. 1972 6 p refs Sponsored by NASA
(E72-10248; NASA-CR-129125) Avail: NTIS HC \$3.00 CSCL 08J

N73-12350*# Geological Survey, Hartford, Conn.

ESTUARINE AND COASTAL WATER DYNAMICS CONTROLLING SEDIMENT MOVEMENT AND PLUME DEVELOPMENT IN LONG ISLAND SOUND Progress Report, 1 Jul. - 31 Aug. 1972

Frederick H. Ruggles, Jr., Principal Investigator 31 Oct. 1972 2 p Sponsored by NASA
(E72-10250; NASA-CR-129127) Avail: NTIS HC \$3.00 CSCL 08H

N73-12351*# Ecole Pratique des Hautes Etudes, Paris (France). MARSHES AND TURBID WATERS Report for Aug. - Oct. 1972

Fernand Verger, Principal Investigator Nov. 1972 14 p Sponsored by NASA
(E72-10251; NASA-CR-129128; SR-31) Avail: NTIS HC \$3.00 CSCL 08H

There are no author-identified significant results in this report. The study of the alluvial zones of the French Atlantic littoral at a taxonomic scale which can bring out the general nature of the sediments and their geomorphic forms is being achieved with the aid of ERTS-1 imagery. It will be necessary to run as many lines as possible to study both the alluvial plains, indicating the seasonal phases of the lowest and highest humidity, as well as the turbidity of littoral waters which change in relation to the tides. A better understanding of these alluvial zones and the origin of the sedimentary forms will not be limited to theoretical interest alone, but will have practical application in numerous fields such as agriculture, shell fishing, and land reclamation.

A.L.

N73-12370*# Geological Survey, Menlo Park, Calif.

PRINCIPLE SOURCES AND DISPERSAL PATTERNS OF SUSPENDED PARTICULATE MATTER IN NEARSHORE SURFACE WATERS OF THE NORTHEAST PACIFIC OCEAN AND THE HAWAIIAN ISLANDS Progress Report, 17 Aug. - 31 Oct. 1972

Paul R. Carlson, Principal Investigator 1 Nov. 1972 4 p
(NASA Order S-70243-AG-7)
(E72-10271; NASA-CR-129233) Avail: NTIS HC \$3.00 CSCL 08J

N73-12377*# National Marine Fisheries Service, Bay Saint Louis, Miss.

INVESTIGATION USING DATA FROM ERTS TO DEVELOP AND IMPLEMENT UTILIZATION OF LIVING MARINE RESOURCES Progress Report, 1 Sep. - 5 Nov. 1972

William H. Stevenson, Principal Investigator 8 Dec. 1972 24 p
(NASA Order S-70246-AG)
(E72-10279; NASA-CR-129249; PR-2) Avail: NTIS HC \$3.00 CSCL 08J

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N73-12381* Arizona Univ., Tucson. Dept. of Biological Sciences.

STUDY OF THE MARINE ENVIRONMENT OF THE NORTHERN GULF OF CALIFORNIA Progress Report, period ending 30 Nov. 1972

J. R. Hendrickson, Principal Investigator 30 Nov. 1972 28 p (Contract NAS5-21777)

(E72-10283; NASA-CR-129252) Avail: NTIS HC \$3.00 CSCL 08A

The author has identified the following significant results. Preliminary analysis of the first three months of ERTS-1 imagery have revealed that the MSS images have particular utility for study of turbidity patterns, current phenomena, and bathymetry throughout the test area. Early indications are that well defined spatial distributions of turbidity exist in the northern Gulf of California, and that for any one point in time, these distributions vary with depth. From a single set of images, as many as 3 turbidity maps may be generated, each indicating a vertical spatial relationship of the turbidity masses. The spatial distribution of turbidity masses depend partially upon the coincident currents. In the band of deepest penetration, a map can be gathered which roughly corresponds to the bathymetry of the area. The extreme tides in the northern Gulf of California result in vast areas which can be classified as intertidal mud flats. Information on the amount of exposure at the varying tidal states is important in analysis of these mud flat areas as nursery ground for Mexican commercial fisheries.

N73-12408 Reading Univ. (England).

OCEANOGRAPHIC APPLICATIONS OF SIDE-LOOKING RADAR

J. R. Hardy /n Elliott-Automation Space and Advan. Mil. Systems Side-looking Radar Systems and Surveys, Vol. 3 Aug. 1972 p 105-122 refs

The oceanographic applications of SLR are discussed particularly in relation to the sea surface area. The present status of work is reviewed, and potential applications of SLR to sea state studies, ocean currents, surface wind sensing, and ocean waves are considered. Author (ESRO)

N73-13156* Joint Publications Research Service, Arlington, Va.

RADAR IMAGE OF THE SURFACE OF THE SEA

S. D. Yeshchenko and B. Sh. Lande 2 Nov. 1972 13 p refs Transl. into ENGLISH from Radiotekh. Elektron. (Moscow), no. 8, 1972 p 1590-1597

(JPRS-57409) Avail: NTIS HC \$3.00

Data are reported from a theoretical investigation of the scattering of radio waves in the centimeter range by the water surface in various hydrological and meteorological conditions. The results of airborne and seaborne experiments in the fixation of radar image for various hydrometeorological conditions.

Author

N73-13339* Institut Français du Pétrole, Paris (France).

DYNAMIC BEHAVIOR OF COASTAL SEDIMENTATION IN THE LIONS GULF Progress Report, Jul. - Nov. 1972

Max Guy, Principal Investigator Dec. 1972 12 p Sponsored by NASA

(E72-10289; NASA-CR-129279; GOLION-1/1) Avail: NTIS HC \$3.00 CSCL 08C

The author has identified the following significant results. The most important result is that MSS 8 and 7 very clearly shows the former shorelines of the Rhone Delta and enable them to be mapped directly. Another result is the change in shape of the Var mouth discharge with changing meteorological conditions. If good photographs of the western part of the Gulf of Lions are available in the future, the GOLION project will be performed as planned.

N73-13340* American Univ., Washington, D.C. Dept. of Biology.

WETLANDS ECOLOGY Progress Report, Jun. - Oct. 1972

Richard R. Anderson, Principal Investigator, Virginia Carter, and John W. McGinness, Jr. Nov. 1972 11 p

(Contract NAS5-21752)

(E72-10290; NASA-CR-129280) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. The ERTS imagery analyzed provides approximately 2/3 coverage of the test site. Analysis was made using visual methods, density slicing, and multispectral analysis. Preliminary conclusions reached are that most, if not all, of the investigation objectives can be met. Saline and near-saline wetlands can be delineated from ERTS-1 images as the wetland-upland boundaries and land-water interface are clearly defined. Major plant species or communities such as *Spartina alterniflora* (high and low vigor forms), *Spartina patens*/*Distichlis spicata*, and *Juncus roemerianus* can be discriminated and spoil disposal areas indentified.

N73-13365* Corps of Engineers, San Francisco, Calif.

CALIFORNIA COAST NEARSHORE PROCESSES STUDY Progress Report, 1 Sep. - 31 Oct. 1972

Douglas M. Pirie, Principal Investigator 31 Oct. 1972 21 p Prepared in cooperation with North Am. Rockwell Corp., Downey, Calif.

(NASA Order S-70257-AG)

(E72-10318; NASA-CR-129565; ERTS-1-I-1) Avail: NTIS HC \$3.25 CSCL 08C

N73-14306 National Lending Library for Science and Technology, Boston Spa (England).

SATELLITE PICTURES AND SEA ICE RECONNAISSANCE: A METHODOLOGICAL ATTEMPT FOR THE BALTIC SEA

K. Struebing [1972] 37 p Transl. into ENGLISH from Deut. Hydrograph. Z. (Hamburg), v. 23, 1970 p 193-213

(NLL-M-20841-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 4 NLL photocopy coupons

A method of interpreting satellite photographs of ice in the Baltic Sea and results of applying the method to 11 TV pictures from ESSA 8 are described in detail. It is felt that the satellite data can be converted to a very accurate and informative ice chart, showing spatial interrelations between ice conditions and hydrological, meteorological, and coast morphological conditions. Also, a synchronous picture of the ice distribution in the whole of the Baltic can be obtained in less than ten minutes after a picture is taken. A disadvantage is the relatively low resolution of the satellite pictures. N.E.N.

N73-14322* Army Engineer Waterways Experiment Station, Vicksburg, Miss.

SEDIMENT PATTERN CORRELATION WITH INFLOW AND TIDAL ACTION Progress Report, 1 Oct. - 30 Nov. 1972

Warren E. Grabau, Principal Investigator 20 Dec. 1972 3 p

(NASA Order S-70259-AG)

(E72-10334; NASA-CR-129648) Avail: NTIS HC \$3.00 CSCL 08C

N73-14328* Earth Satellite Corp., Washington, D.C.

AN INVESTIGATION TO IMPROVE THE MENHADEN FISHERY PREDICTION AND DETECTION MODEL THROUGH THE APPLICATION OF ERTS-A DATA Interim Report, May - Dec. 1972

Paul M. Maughan, Principal Investigator Dec. 1972 29 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(Contract NAS5-21743)

(E72-10340; NASA-CR-129654) Avail: NTIS HC \$3.50 CSCL 08J

The author has identified the following significant results. Preliminary analyses indicate that several important relationships

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have been observed utilizing ERTS-1 imagery. Of most significance is that in the Mississippi Sound, as elsewhere, considerable detail exists as to turbidity patterns in the water column. Simple analysis is complicated by the apparent interaction between actual turbidity, turbidity induced by shoal water, and actual imaging of the bottom in extreme shoal water. A statistical approach is being explored which shows promise of at least partially separating these effects so that partitioning of true turbid plumes can be accomplished. This partitioning is of great importance to this program in that supportive data seem to indicate that menhaden occur more frequently in turbid areas. In this connection four individual captures have been associated with a major turbid feature imaged on 8 August. If a significant relationship between imaged turbid features and catch distribution can be established, for example by graphic and/or numeric analysis, it will represent a major advancement for short term prediction of commercially accessible menhaden.

N73-14335*# Alaska Univ., College.
SEA, ICE AND SURFACE WATER CIRCULATION, ALASKAN CONTINENTAL SHELF Bimonthly Progress Report
Frederick F. Wright, Principal Investigator and G. D. Sharma
30 Nov. 1972 3 p
(Contract NAS5-21833)
(E72-10347; NASA-CR-129661; BMPR-2) Avail: NTIS HC \$3.00 CSCL 08C

The author has identified the following significant results. Two cruises were conducted in Cook Inlet to obtain ground truth. Forty-seven stations during 22-23 August and 68 stations during 25-29 September 1972 were occupied and temperature, salinity, percent light transmission, and suspended load of surface waters obtained. Similar data at various depths was also obtained at selected stations. Cook Inlet is an estuary with complex mixing of river discharges and ocean water. The Upper Cook Inlet shows a gradual and systematic decrease in salinity, however, west of Kenai the mixing of waters is complex. The sediments in suspension originating at the head of the inlet generally settle out east of Kenai and Drift River. Sediment load in suspension decreased gradually, from 1700 mg/l near Anchorage to about 50 mg/l in the Narrows. In the Lower Cook Inlet the suspended load varied between 1-10 mg/l. Surface waters with sediments in suspension and ocean water with relatively lower sediment concentration are clearly discernible in ERTS-1 images obtained during September 18, 1972 pass over Cook Inlet. The movement and mixing of these waters can also be delineated in the images.

N73-14336*# Alaska Univ., College.
CIRCULATION OF PRINCE WILLIAM SOUND Bimonthly Progress Report
Robin D. Muench, Principal Investigator 30 Nov. 1972 4 p
(Contract NAS5-21833)
(E72-10348; NASA-CR-129662; BMPR-2) Avail: NTIS HC \$3.00 CSCL 08C

The author has identified the following significant results. Visual examination of the available ERTS-1 and NASA NP-3 aircraft imagery has suggested that sediment-laden plumes from rivers may be useful in tracking surface circulation over the regions where these plumes retain their visible identities. Plumes of ice derived from tidewater glaciers are highly visible on the ERTS-1 imagery, but are generally of too small an areal extent to be useful in tracing surface circulation. Shore-fast ice is also highly visible on the ERTS-1 data. Practical scientific results include a corroboration of the westward flow just offshore in the Gulf of Alaska with inflow through Hinchinbrook Entrance into Prince William Sound. The tracer in this case was the Copper River Plume, which originates at the mouth of the Copper River east of Prince William Sound. A single partial image of Port Valdez, in northeastern Prince William Sound, suggests by the visible suspended sediment distribution that surface circulation there was cyclonic, as deduced previously from oceanographic baseline data. Surf along the shoreline of the Gulf of Alaska is highly visible on ERTS-1 imagery.

N73-14355*# Old Dominion Univ. Research Foundation, Norfolk, Va.

[USE OF ERTS IMAGERY IN AIR POLLUTION AND MARINE BIOLOGY STUDIES, TASKS 1 THROUGH 3] Bimonthly Report, 1 Oct. - 30 Nov. 1972

G. E. Copeland, John C. Ludwick, Harold G. Marshall, Principal Investigators, A. R. Bandy, P. Fleischer, W. J. Hanna, T. A. Gosink, and D. W. Bowker 30 Nov. 1972 22 p
(Contract NAS5-21816)

(E72-10367; NASA-CR-129800) Avail: NTIS HC \$3.25 CSCL 08A

There are no author-identified significant results in this report. The general suitability of ERTS imagery in detecting ground originated air pollution has proved to be excellent. The quality and resolution exceeded expectations and has permitted in some instances location of point sources to within a thousand feet. Suitable techniques have not yet been developed for determining or measuring area and line sources of air pollution. A major problem has been cloud cover that has persisted over the area of primary interest, the Chesapeake Bay. Work has been completed on mounting the shipboard transmissometer which will be used for investigations to relate the chlorophyll and suspended sediment content in the waters of the Lower Chesapeake Bay to ERTS-1 imagery. Water sampling, plankton analysis, and preparations for sea collection of water truth along the eastern continental shelf of the U.S. have been completed for use in comparisons with ERTS-1 data. A.L.

N73-15338*# International Imaging Systems, Mountain View, Calif.

PROPOSAL FOR OCEAN WATER COLOR ASSESSMENT FROM ERTS-A RBV AND MSS IMAGERY Progress Report, Nov. - Dec. 1972

Donald S. Ross, Principal Investigator Dec. 1972 1 p
(Contract NAS5-21862)

(E73-10002; NASA-CR-129926) Avail: NTIS HC \$3.00 CSCL 08J

N73-15343*# Delaware Univ., Newark. Coll. of Marine Studies.
APPLICATION OF ECOLOGICAL, GEOLOGICAL AND OCEANOGRAPHIC ERTS-1 IMAGERY TO DELAWARE'S COASTAL RESOURCES PLANNING

V. Klemas, Principal Investigator and D. Bartlett 11 Jan. 1973 4 p

(Contract NAS5-21837)

(E73-10007; NASA-CR-129931) Avail: NTIS HC \$3.00 CSCL 08J

N73-15346*# Long Island Univ., Greenvale, N.Y. Science Engineering Research Group.

AN INTERDISCIPLINARY STUDY OF THE ESTUARINE AND COASTAL OCEANOGRAPHY OF BLOCK ISLAND SOUND AND ADJACENT NEW YORK COASTAL WATERS Interim Report, Jul. - Dec. 1972

Edward F. Yost, Principal Investigator Dec. 1972 51 p Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(Contract NAS5-21792)

(E73-10010; NASA-CR-129936; TR-20-1) Avail: NTIS HC \$4.75 CSCL 08C

The author has identified the following significant results. The synoptic repetitive coverage of the multispectral imagery from the ERTS-1 satellite, when photographically reprocessed using the state-of-the-art techniques, has given indication of spectral differences in Block Island and adjacent New England waters which were heretofore unknown. Of particular interest was the possible detection of relatively small amounts of phytoplankton prior to the occurrence of the red tide in Massachusetts waters. Preparation of spatial and temporal hydrographic charts using ERTS-1 imagery and ground truth

analysis will hopefully determine the environmental impact on New York coastal waters.

N73-15353*# National Environmental Satellite Service, Washington, D.C.
EVALUATION OF ERTS DATA FOR CERTAIN OCEANOGRAPHIC USES Progress Report, Oct. - Dec. 1972
 Alan E. Strong, Principal Investigator Dec. 1972 3 p
 (NASA Order S-70246-AG)
 (E73-10017; NASA-CR-129943) Avail: NTIS HC \$3.00 CSCI 08C

The author has identified the following significant results. A thick algal mat in the Bass Islands area several hundred feet wide and 10-15 miles long can be seen along the western edge of the ERTS-1 imagery.

N73-15353*# National Oceanic and Atmospheric Administration, Miami, Fla.
REMOTE SENSING OF OCEAN CURRENTS Bimonthly Report, 4 Nov. 1972 - 4 Jan. 1973
 George A. Maul, Principal Investigator 4 Jan. 1973 6 p
 (NASA Order S-70246-AG)
 (E73-10030; NASA-CR-129970) Avail: NTIS HC \$3.00 CSCI 08C

N73-15359*# National Oceanic and Atmospheric Administration, Miami, Fla.
SEA SURFACE TOPOGRAPHY FROM SPACE, VOLUME 1
 John R. Apel, ed. Boulder, Colo. Feb. 1972 384 p refs
 Proc. of Conf. held at Key Biscayne, Florida, 6-8 Oct. 1971; sponsored by NOAA, NASA, and US Navy
 (NASA-CR-130293; NOAA-TR-ERL-228-AOML-7-Vol-1) Avail: NTIS MF \$0.95; SOD HC \$1.25 CSCI 08C

Conference proceedings covering the problems associated with measuring sea undulations from spacecraft or aircraft, using laser or radar instrumentation, are presented. Detailed summaries are given of system designs, tracking and orbit analysis, geodesy and ground truth, oceanography and meteorology, and radar systems and subsystems. Altimeters for use on both Skylab and GEOS-C satellites are also examined.

N73-15354* New York Univ., N.Y. Dept. of Meteorology and Oceanography.
SKYLAB S193 AND THE ANALYSIS OF THE WIND FIELD OVER THE OCEAN
 Willard J. Pierson, Jr. In NOAA Sea Surface Topography from Space, Vol. 1 Feb. 1972 20 p refs

(Contracts NAS1-10090; N62306-70-A-0075-0007)
 (Contrib-118) CSCI 04B

The present status of the program to provide proof of concept for the idea that simultaneously observed radar scattering cross section measurements and passive microwave measurements can be used to determine the winds in the planetary boundary layer over the ocean, is given. The role of S193 in Skylab is providing the final clinching proof that an operational instrument will obtain data of great value to both meteorology and oceanography is described.

Author

N73-15355* Battelle Memorial Inst., Columbus, Ohio.
DETERMINATION OF MEAN SURFACE POSITION AND SEA STATE FROM THE RADAR RETURN OF A SHORT-PULSE SATELLITE ALTIMETER
 Donald E. Barrick In NOAA Sea Surface Topography from Space, Vol. 1 Feb. 1972 19 p refs (For availability see N73-15359 08-13)
 CSCI 08C

Using the specular point theory of scatter from a very rough

surface, the average backscatter cross section per unit area per radar cell width is derived for a cell located at a given height above the mean sea surface. This result is then applied to predict the average radar cross section observed by a short-pulse altimeter as a function of time for two modes of operation: pulse-limited and beam-limited configurations. For a pulse-limited satellite altimeter, a family of curves is calculated showing the distortion of the leading edge of the receiver output signal as a function of sea state (i.e., wind speed). A signal processing scheme is discussed that permits an accurate determination of the mean surface position--even in high seas--and, as a by-product, the estimation of the significant seawave height (or wind speed above the surface). Comparison of these analytical results with experimental data for both pulse-limited and beam-limited operation lends credence to the model. Such a model should aid in the design of short-pulse altimeters for accurate determination of the geoid over the oceans, as well as for the use of such altimeters for orbital sea-state monitoring.

Author

N73-15359* Technology Service Corp., Silver Spring, Md. Washington Operations.
RADAR PULSE COMPRESSION AND HIGH RESOLUTION SEA REFLECTIVITY
 Fred E. Nathanson In NOAA Sea Surface Topography from Space, Vol. 1 Feb. 1972 11 p refs

CSCI 08C

The state-of-the-art in radar pulse compression as it applies to spacecraft altimetry is summarized. It is illustrated how in the next few years vertical resolutions to 0.5 to 2.0 ft. can be obtained with relative accuracies of 5 to 10% of these values if the nature of the sea surface is known. Data are also given that show when high accuracy is desired, second order effects such as the asymmetries in the sea surface reflectivity may be taken into account.

Author

N73-15391* Tetra Tech, Inc., Pasadena, Calif.
FEASIBILITY OF MICROWAVE HOLOGRAPHY FOR IMAGING THE SEA SURFACE
 Willard Wells In NOAA Sea Surface Topography from Space, Vol. 1 Feb. 1972 13 p

CSCI 20E

The possibility of imaging the sea surface in three dimensions by means of microwave holography from a low-flying aircraft is considered. Data cover a brief feasibility study and a review of some computer experiments in which it was demonstrated that it is possible to compute three-dimensional images of objects from raw holographic data recorded on magnetic tape. These experiments used synthetic data.

Author

N73-15392*# National Oceanic and Atmospheric Administration, Miami, Fla. Atlantic Oceanographic and Meteorological Lab.
SEA SURFACE TOPOGRAPHY FROM SPACE, VOLUME 2
 John R. Apel, ed. Boulder, Colo. May 1972 148 p refs
 Proc. of Conf. held at Key Biscayne, Fla., 6-8 Oct. 1971; sponsored jointly by NASA, NOAA, and Navy
 (NASA-CR-129993; NOAA-TR-ERL-228-AOML-7-2-Vol-2) Avail: NTIS MF \$0.95; SOD HC \$1.25 CSCI 08C

The distortions that a dynamic moving ocean surface introduces on topographical sea surface measurements by orbiting satellite instrumentation are considered.

N73-15393* Lamont-Doherty Geological Observatory, Palisades, N.Y.
GRAVIMETRICALLY DETERMINED GEOID IN THE WESTERN NORTH ATLANTIC
 Manik Talwani, Herbert R. Poppe, and Philip D. Rabinowitz In NOAA Sea Surface Topography from Space, Vol. 2 May 1972 34 p refs
 (Contracts N00014-67-A-0108-004; Nonr-266(79); Grants NSF GA-17761; NSF GA-27281)
 CSCI 08C

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A detailed gravimetric geoid for the western North Atlantic is obtained by correlating satellite-borne gravity measurements with topographical sea surface data to construct maps of free air gravity. G.G.

N73-15394* Rhode Island Univ., Kingston.
COMMENTS ON OCEAN CIRCULATION WITH REGARD TO SATELLITE ALTIMETRY
Wilton Sturges *In NOAA Sea Surface Topography from Space*. Vol. 2 May 1972 17 p refs

CSCL 08C

Basic features of sea surface topography are reviewed, to show those oceanographic results which may be of value to a geodetic satellite program: (1) the shape and magnitude of the large scale features of the mean sea surface, relative to a level surface; (2) the position and magnitude of the slopes across the western boundary currents, from a variety of data; (3) an estimate of the position of the geoid, tied into the U.S. leveling network; and (4) a documented change of 60 to 70 cm in mean sea level, with respect to the geoid, between the U.S. east and west coasts. Author

N73-15395* Woods Hole Oceanographic Institution, Mass.
THE ENERGY BALANCE OF WIND WAVES AND THE REMOTE SENSING PROBLEM
Klaus Hasselmann *In NOAA Sea Surface Topography from Space*, Vol. 2 May 1972 55 p refs

CSCL 08C

Measurements of wave growth indicate an energy balance of the wave spectrum governed primarily by input from the atmosphere, nonlinear transfer to shorter and longer waves, and advection. The pronounced spectral peak and sharp low frequency cut-off characteristic of fetch-limited spectra are explained as a self-stabilizing feature of the nonlinear wave-wave interactions. The momentum transferred from the atmosphere to the wind waves accounts for a large part of the wind drag. These findings are relevant for remote microwave sensing of the sea surface by backscatter and passive radiometry methods. Author

N73-15396* National Oceanic and Atmospheric Administration, Miami, Fla. Atlantic Oceanographic and Meteorological Labs.
TIDES AND TSUNAMIS
Bernard D. Zetler *In its Sea Surface Topography from Space*. Vol. 2 May 1972 30 p

CSCL 08C

Although tides and tsunamis are both shallow water waves, it does not follow that they are equally amenable to an observational program using an orbiting altimeter on a satellite. A numerical feasibility investigation using a hypothetical satellite orbit, real tide observations, and sequentially increased levels of white noise has been conducted to study the degradation of the tidal harmonic constants caused by adding noise to the tide data. Tsunami waves, possibly a foot high and one hundred miles long, must be measured in individual orbits, thus requiring high relative resolution. Author

N73-16289 Kansas Univ., Lawrence.
REMOTE SENSING OF OCEAN WINDS USING A RADAR SCATTEROMETER Ph.D. Thesis
Gerald Arthur Bradley 1971 210 p
Avail: Univ. Microfilms Order No. 72-11732

The purpose is to show the relationship between radar scattering coefficient and ocean wind speed and direction using measurement data taken by a radar scatterometer operating at a frequency of 13.3 GHz with vertical polarization. It is shown that past experimental and theoretical results have indicated a possible dependency of the radar scattering coefficient on the

ocean wind speed and direction. It is shown that problems encountered early in the research program with the radar, equipment required a system analysis study to be performed in order to assure valid data measurements. The results are presented and are used to interpret and adjust the measured data in order to investigate the relationship between radar scattering coefficient and ocean wind information. Dissert. Abstr.

N73-16312* Army Coastal Engineering Research Center, Washington, D.C.
APPLICATION OF NASA ERTS-1 SATELLITE IMAGERY IN COASTAL STUDIES

Orville T. Magoon, Dennis W. Berg, Principal Investigators, and Robert J. Hallermeier [1973] 15 p refs Presented at ASCE Water Resources Conf., Washington, 29 Jan. 1973, and proposed for presentation at Goddard ERTS Symp., Greenbelt, Md., 5 Mar. 1973

(NASA Order S-70257-AG)

(E73-10050; NASA-CR-130328) Avail: NTIS HC \$3.00 CSCL 08C

There are no author-identified significant results in this report. Review of ERTS-1 imagery indicates that it contains information of great value in coastal engineering studies. A brief introduction is given to the methods by which imagery is generated, and examples of its application to coastal engineering. Specific applications discussed include study of the movement of coastal and nearshore sediment-laden water masses and information for planning and construction in remote areas of the world.

N73-16356* National Oceanic and Atmospheric Administration, Washington, D.C.

REMOTE SENSING OCEANOGRAPHY

John W. Sherman, III *In NASA, Washington, Intern. Workshop on Earth Resources Surv. Systems*, Vol. 1 1972 p 91-105 refs

CSCL 08C

The application of electromagnetic sensors to the study of the oceans is discussed. The areas of feasible application are defined. The properties of the ocean which affect the use of electromagnetic sensors are analyzed. Examples of multispectral photography of the ocean surface and a submersible vehicle are provided. Specific references are made to: (1) ocean color analysis, (2) sea ice, (3) shoal and coastal mapping, (4) coastal marine processes, and (5) synoptic oceanography. P.N.F.

N73-16407* Scripps Institution of Oceanography, La Jolla, Calif.
EXPLORATION OF MARINE RESOURCES BY PHOTOGRAPHIC REMOTE SENSING

Seibert Q. Duntley, Robert E. Stevenson (ONR), and Almerian R. Boileau *In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems*, Vol. 2 1971 p 526-550

CSCL 08C

The interpretation of photographs in oceanographic remote sensing is discussed. The photographs were made from spacecraft with two exceptions. Two photographs were made from aircraft. There were three types of film used to make the photographs: black-and-white, color, and color IR. Black and white photography is well known; it presents pictures in various shades of gray from black to white. Color film presents pictures in color, very nearly as the human eye sees them. Color IR film presents pictures in color also but not as seen by the human eye. Blue becomes much deeper blue, green is suppressed to some extent, and red is recorded beyond the visual range of the human eye, out in the near infrared. The most noticeable effect of the use of color IR film is that leaf materials which are highly reflective in the infrared part of the spectrum are presented as red. Author

N73-16408* Naval Oceanographic Office, Washington, D.C.
OCEANOGRAPHIC INTERPRETATION OF APOLLO PHOTOGRAPHS. COASTAL OCEANOGRAPHIC AND SEDIMENT

TOLOGIC INTERPRETATION OF APOLLO 9 SPACE PHOTOGRAPHS; CAROLINA'S CONTINENTAL SHELF, USA
Robert L. Mairs / In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 2 1971 p 552-579
refs

CSCL 08C

Apollo 9 photographs, color band separations, and oceanographic and meteorological data are used in the study of the origin, movement, and dissipation of masses of discolored water near the shores of North and South Carolina. A model has been developed incorporating jet theory, climatology, currents, surface temperatures, color separations, and other oceanographic data to explain the processes involved in the life cycle of the discolored water masses. Special treatment is afforded the Gulf Stream boundary definition and the Cape Hatteras oceanographic barrier.
Author

N73-16409* National Environmental Satellite Service, Washington, D.C.

REMOTE SENSING OF SEA ICE FROM EARTH SATELLITES
E. Paul McClain / In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 2 1971 p 580-593
refs

CSCL 08L

The application of meteorological satellite data for mapping ice fields is discussed. The characteristics of the photographic records of sea ice formations are described. The derivation of the composite minimum brightness chart by computer processing of the mapped satellite vidicon data for several successive days is explained. The factors which create a quantitative delimiting of the sea ice conditions are explained.
Author

N73-16410* National Environmental Satellite Service, Washington, D.C.

REMOTE SENSING OF SEA SURFACE TEMPERATURE FROM EARTH SATELLITES
P. Krishna Rao / In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 2 1971 p 594-606
refs

CSCL 08J

Techniques for measuring sea surface temperature using remote sensors in earth orbiting satellites are discussed. Specific reference is made to the infrared sensors carried by the TIROS Operational Satellite. The development of a method to examine a large number of measurements in order to differentiate the temperature effects of clouds is described. It is stated that the system used is completely objective and minimizes the influence of atmospheric absorption, cloud contamination, and instrumental noise on the inferred sea surface temperatures.
Author

N73-17286* Arizona Univ., Tucson. Dept. of Biology Sciences. **STUDY OF THE MARINE ENVIRONMENT OF THE NORTHERN GULF OF CALIFORNIA** Progress Report, 21 Jun. - 31 Dec. 1972

John R. Hendrickson, Principal Investigator 20 Jan. 1973 89 p Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
(Contract NAS5-21777)

(E73-10021; NASA-CR-129951) Avail: NTIS HC \$6.50 CSCL 08A

There are no author-identified significant results in this report. Progress in studies of the marine environment of the northern Gulf of California is described. A ship was chartered in Mexico, staffed with local seamen, equipped for oceanographic work, and is now conducting monthly cruises of 47 stations, collecting ground observations for correlation with ERTS-1 imagery in the Arizona Regional Ecological Test Site laboratory in Tucson. Progress is reported on fabrication of instrument buoys equipped with marine-adapted DCP's to transmit ground observations via satellite to Tucson. Data handling processes are described. Coordination of work with Mexican scientists is detailed.

N73-17291* Earth Satellite Corp., Washington, D.C.

INVESTIGATION TO IMPROVE MENHADEN FISHERY PREDICTION Progress Report, 1 Dec. 1972 - 31 Jan. 1973
Paul M. Maughan, Principal Investigator 9 Feb. 1973 4 p
(Contract NAS5-21743)
(E73-10079; NASA-CR-130374) Avail: NTIS HC \$3.00 CSCL 08A

The author has identified the following significant results. There are sufficient data to indicate that in at least one instance menhaden were found in a deepwater plume apparent from ERTS imagery. This association, discovered from an image acquired on 29 September, was retrospectively seen to have persisted for three days. Neither the prior history of the plume nor its persistence after the last day of fishing is known at this time. Some information may be forthcoming from examination of data taken by other participants in the experiment.

N73-17308* Old Dominion Univ. Research Foundation, Norfolk, Va.

USE OF ERTS-1 TO UTILIZE AND APPLY MARINE STATION DATA TO STUDY OF PRODUCTIVITY ALONG EASTERN SHELF EXPANDED WATERS OF US Semiannual Report, 4 Aug. 1972 - 31 Jan. 1973

Harold G. Marshall, Principal Investigator and David E. Bowker 31 Jan. 1973 4 p

(Contract NAS5-21816)

(E73-10097; NASA-CR-130525) Avail: NTIS HC \$3.00 CSCL 08J

N73-17486* Environmental Research and Technology, Inc., Lexington, Mass.

USE OF ERTS DATA FOR MAPPING ARCTIC SEA ICE Progress Report, 28 Jun. - 31 Dec. 1972

James C. Barnes, Principal Investigator and C. James Bowley Feb. 1973 29 p

(Contract NAS5-21802)

(E73-10278; NASA-CR-130561; ERT-P-408-3) Avail: NTIS HC \$3.50 CSCL 08B

N73-17496* Alaska Univ., Fairbanks. Inst. of Marine Science. **THE CIRCULATION OF PRINCE WILLIAM SOUND** Progress Report, Jul. 1972 - Jan. 1973

Robin D. Muench, Principal Investigator 20 Feb. 1973 12 p
(Contract NAS5-21833)

(E73-10291; NASA-CR-130574) Avail: NTIS HC \$3.00 CSCL 08C

The author has identified the following significant results. Results suggest that sediment-laden plumes of fresh water from rivers may be useful tracers, due to their high visibility, of surface water motion. The two useable images obtained to date corroborate that westerly flow was occurring in the Gulf of Alaska just south of Prince William Sound, and that an inflow into Prince William Sound was occurring concurrently with flood tides on both occasions. River plumes are useful tracers, but poor weather conditions somewhat limit the use of satellite imagery.

N73-17510* Tracor, Inc., Austin, Tex.

TRINITY BAY STUDY: DYE TRACING EXPERIMENTS

George H. Ward, Jr. Nov. 1972 132 p refs

(Contract NAS9-12724; TRACOR Proj. 077-021)

(NASA-CR-128734; T72-AU-9601-U) Avail: NTIS HC \$8.75 CSCL 08C

An analysis of the heat balance and temperature distribution within Trinity Bay, near Galveston, Texas is presented. The effects of tidal currents, wind driven circulations, and large volume inflows are examined. Emphasis is placed on the effects of turbulent diffusion and local shears in currents. The technique of dye tracing to determine the parameters characterizing dispersion is described. Aerial photographs and maps are provided to show the flow conditions existing at different times and seasons.
Author

N73-17938* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

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A MULTISPECTRAL METHOD OF DETERMINING SEA SURFACE TEMPERATURES

William E. Shenk *In its Significant Accomplishments in Sci.*, 1971 1972 p 19-23
CSCL 08C

Three channels of the Nimbus 2 medium resolution infrared radiometer were used. One channel, in the absence of clouds, sensed the radiance from the sea surface and the intervening atmosphere, and the other two channels tested for cloud presence. J.A.M.

N73-17939* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md. MEASUREMENTS OF OCEAN COLOR

Warren A. Hovis *In its Significant Accomplishments in Sci.*, 1971 1972 p 24-29
CSCL 08J

Phytoplankton density is determined by ocean color measurements. Phytoplankton is detected by remote sensing systems, because they contain chlorophyll. Chlorophyll has two strong absorption bands in the visible spectrum. The algae *Chlorella* shows the strongest absorptions at 450 and 675 nm. The measured spectrum of ocean color at low and high altitudes is shown. J.A.M.

N73-18336*# Arizona Univ., Tucson. Dept. of Biological Sciences. STUDY OF THE MARINE ENVIRONMENT OF THE NORTHERN GULF OF CALIFORNIA Progress Report, period ending 28 Feb. 1973

J. R. Hendrickson, Principal Investigator 28 Feb. 1973 7 p (Contract NAS5-21777)
(E73-10304; NASA-CR-130716) Avail: NTIS HC \$3.00 CSCL 08A

N73-18346*# Geological Survey, Menlo Park, Calif. PRINCIPAL SOURCES AND DISPERSAL PATTERNS OF SUSPENDED PARTICULATE MATTER IN NEARSHORE SURFACE WATERS OF THE NORTHEAST PACIFIC OCEAN AND THE HAWAIIAN ISLANDS Progress Report, 1 Nov. - 31 Dec. 1972

Paul R. Carlson, Principal Investigator 1 Jan. 1973 5 p (NASA Order S-70243-AG-7)
(E73-10314; NASA-CR-130732) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. Numerous geologic features can be discerned on ERTS-1 imagery of the northwestern Olympic Peninsula, Washington, and southern Vancouver Island, British Columbia. A thick homoclinal sequence of north-dipping Tertiary marine strata along the northwestern Olympic Peninsula is readily discernible because of the banded nature of its outcrop. The submarine basalt on which the sequence rests shows as a high, rugged ridge. Within the sedimentary sequence, alternating sandstone and siltstone members 100 m or more thick show in the southeast corner of the image. Broad, folds in this banded sequence and faults that cut it can be detected. One large fault, the Pysht River fault, and a large syncline in sandstone and siltstone east of it show prominently on the image. Numerous lineations on the image of southern Vancouver Island correlate with faults shown on Muller's map. Particularly prominent are the Leech River and San Juan faults along the southernmost part of the island.

N73-19330*# National Oceanic and Atmospheric Administration, Miami, Fla. REMOTE SENSING OF OCEAN CURRENTS Bimonthly Report, 4 Jan. - 4 Mar. 1973

George A. Maul, Principal Investigator 4 Mar. 1973 8 p (NASA Order S-70246-AG)
(E73-10022; NASA-CR-130835) Avail: NTIS HC \$3.00 CSCL 08J

N73-19340*# Ecole Pratique des Hautes Etudes, Paris (France).

MARSHES AND TURBID WATERS IN THE FRENCH ATLANTIC LITTORAL Progress Report, Oct. 1972 - Feb. 1973

Fernand Verger, Principal Investigator 28 Feb. 1973 43 p Sponsored by NASA Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 (E73-10341; NASA-CR-130800) Avail: NTIS HC \$4.25 CSCL 08C

The author has identified the following significant results. The multispectral information provided by ERTS-1 is very rich for the coastal regions but the cloud cover, even when only partial, often cuts up the data, and lessens its practical value. The research by densitometric methods has thus far been the most fruitful. It consists of measuring densities along preferential axes. This method has enabled the investigators to perfect a system of computer cartography for the best image. Comparative study of microdensitometric transects in four MSS bands for carefully delimited profiles on the ground, makes it possible to isolate and recognize various types of countryside: (1) countryside of coastal plains; (2) countryside of coastal sand dunes and beaches; and (3) forms and processes of offshore domains. This Study shows the usefulness of the ERTS program in establishing a rapid cartography of the physiographic units of the coastal plains in the interest of a rational program of exploitation and development.

N73-19352*# National Environmental Satellite Service, Washington, D.C. EVALUATION OF ERTS DATA FOR CERTAIN OCEANOGRAPHIC USES Progress Report, Jan. - Feb. 1973

Alan E. Strong, Principal Investigator Feb. 1973 2 p (NASA Order S-70246-AG)
(E73-10356; NASA-CR-130971) Avail: NTIS HC \$3.00 CSCL 08A

N73-19364*# Delaware Univ., Newark. Coll. of Marine Studies. APPLICABILITY OF ERTS-1 IMAGERY TO THE STUDY OF SUSPENDED SEDIMENT AND AQUATIC FRONTS

V. Klemas, Principal Investigator, R. Srna, W. Treasure, and M. Otley 20 Mar. 1973 17 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 (Contract NAS5-21837; Grant NSF GI-33369; NOAA-GH-109)
(E73-10368; NASA-CR-131009) Avail: NTIS HC \$3.00 CSCL 08H

N73-19369*# Environmental Research and Technology, Inc., Lexington, Mass. EVALUATE THE APPLICATION OF ERTS-A DATA FOR DETECTING AND MAPPING SEA ICE Bimonthly Progress Report, 31 Dec. 1972 - 28 Feb. 1973

James C. Barnes, Principal Investigator 21 Mar. 1973 7 p (Contract NAS5-21802)
(E73-10374; NASA-CR-131015; ERT-P-408-4; BMPR-4) Avail: NTIS HC \$3.00 CSCL 08L

The author has identified the following significant results. Sea ice is detectable in all of the ERTS-1 MSS bands and can be distinguished from clouds through a number of interpretive keys. Considerable information on ice type can be derived from the ERTS-1 data. Ice types that appear to be identifiable include: ice floes of various categories, pack ice of various concentrations, ice belts, brash ice, rotten ice, fast ice, leads, fractures, cracks, puddles, thaw holes, and flooded ice. Although larger icebergs can be seen, it is difficult to distinguish them from ice floes. Ice features as small as the small floe of 20 to 100 m across can be detected, and the sizes of features somewhat smaller than 100 m can be measured from enlarged ERTS-1 prints. The multispectral analysis of the ERTS-1 MSS-7 bands provides much information on ice type and ice surface features that cannot be derived from a single spectral band. For example, thaw holes can often be distinguished from puddles because of their different appearances in the two bands. These surface features can be indicative of ice age. Furthermore, snow

lines on glaciers can be reliably mapped through the joint use of the MSS-4 and 7 data.

N73-19381# Joint Publications Research Service, Arlington, Va.

AERIAL PHOTOGRAPHIC AND ELECTROMAGNETIC DETERMINATION OF THE SEA SURFACE AND ITS CONDUCTIVITY

2 Mar. 1973 25 p refs Transl. into ENGLISH from Okeanologiya (Moscow), no. 6 1972

(JPRS-58370) Avail: NTIS HC \$3.25

An article on the relationship between wave parameters and the spatial spectrum of aerial photographs and radar images of the sea surface is presented. The use of an electromagnetic method for measuring the conductivity of the sea surface layer is described.

N73-19382 Joint Publications Research Service, Arlington, Va. **ELECTROMAGNETIC METHOD OF MEASUREMENT OF THE SEA SURFACE LAYER CONDUCTIVITY**

A. G. Kravtsov In its Aerial Phot. and Electromagnetic Determination of the Sea Surface and its Conductivity 2 Mar. 1973 p 1-6 refs

A method of determining the conductivity in the surface layer of the sea according to the recording of the field of remote transmitters of a common time system operating in the superlong-wave range, is considered. The results of an experiment in the littoral zone of the Black Sea are given. The conclusion is made that the method is applicable up to depths of several tens of meters in operation from a trestle, a buoy, and a towed device. The range of depths may be expanded by means of a transition to the recording of low-frequency fields created by atmospheric noises, but at great depths it is feasible to use an autonomous source of low-frequency oscillations. Author

N73-19383 Joint Publications Research Service, Arlington, Va. **THE RELATIONSHIP BETWEEN WAVE PARAMETERS AND THE SPATIAL SPECTRUM OF AERIAL PHOTOGRAPHS AND RADAR IMAGES OF THE SEA SURFACE**

I. M. Bondarenko, A. A. Zagorodnikov, V. S. Loshchilov, and K. B. Chelyshev In its Aerial Phot. and Electromagnetic Determination of the Sea Surface and its Conductivity 2 Mar. 1973 p 7-22 refs.

The derivation of algorithms correlating the spectra of wave conditions with two dimensional spectra of aerial photographs and radar images of the surface of the sea is given. It is demonstrated that the two dimensional spectra of aerial photographs and radar images of this surface contain information concerning the various characteristics of sea waves. Based on this information it is possible to calculate such complex characteristics as one dimensional and two dimensional spectra. Author

N73-20346*# Alaska Univ., Fairbanks. Inst. of Marine Science. **SEA-SURFACE CIRCULATION, SEDIMENT TRANSPORT, AND MARINE MAMMAL DISTRIBUTION, ALASKA CONTINENTAL SHELF** Progress Report, Jul. 1972 - Jan. 1973

Frederick F. Wright, Principal Investigator, G. D. Sharma, and J. J. Burns 20 Feb. 1973 37 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 (Contract NAS5-21833)

(E73-10370; NASA-CR-131011) Avail: NTIS HC \$4.00 CSCL 08A

The author has identified the following significant results. Even though nonsynchronous, the ERTS-1 imagery of November 4, 1972, showed a striking similarity to the ground truth data obtained in late August and September, 1972. The comparison of the images with ground truth data revealed that the general water circulation pattern in Lower Cook Inlet is consistent through the Fall season and that ERTS-1 images in MSS bands 4 and 5 are capable of delineating water masses with a suspended load as low as 1 mg/liter. The ERTS-1 data and the ground truth data demonstrate clearly that the coriolis

effect dominates circulation in Lower Cook Inlet. The configuration of plumes in Nushagak and Kuskokwim bays further indicates the influence of the coriolis effect on the movement of sea water at high latitudes. Comparison of MSS bands 4, 5, 6, and 7 suggest MSS-1 penetration of several meters into the water column. Sea ice analysis of available imagery was exceptionally rewarding. The imagery provided a rapid method to delineate and describe the ice types apparent in the photos. The ice types ranged from newly formed grease ice to heavy flows of disintegrating shore-fast ice. Sea ice maps showing the extent of different ice zones in the Chukchi Sea are being compiled.

N73-20347*# Earth Satellite Corp., Washington, D.C.

APPLICATION OF ERTS-1 DATA TO THE PROTECTION AND MANAGEMENT OF NEW JERSEY'S COASTAL ENVIRONMENT Semiannual Progress Report

Roland S. Yunghans, Edward B. Feinberg, Frank J. Wobber, Robert L. Mairs, Principal Investigators, Donald Garofalo, David A. Thibault, Roger V. Amato, and Lawrence R. Pettinger 12 Jan. 1973 61 p Prepared for N. J. Dept. of Environ. Protection (Contract NAS5-21765)

(E73-10022; NASA-CR-129952) Avail: NTIS HC \$5.25 CSCL 08J

The author has identified the following significant results. This catalogue was prepared as a part of the joint ERTS-1 New Jersey coastal mapping experiment. First look analysis of ERTS-1 images indicates that numerous coastal oceanographic patterns can be mapped on a sequential basis using ERTS-1 images. Analysis of imagery indicates a predominant southwesterly drift of dumped wastes in the surface waters. Initial analysis of imagery indicates that the effects of tidal flushing of New York harbor extend as far south as Long Branch, New Jersey. Analysis of imagery from 3 September, 1972, indicates a wide band of turbid water extending several miles offshore around Barnegat Inlet. First look analysis of imagery from 10 October, 1972, illustrates the increased reflectance of turbid waters within the bays, sounds, and thoroughfares behind the barrier islands in the southern New Jersey shore area. The estuarine waters emanating from both Brigantine and Absecon Inlets are very turbid relative to the waters further offshore and to the north and south. The tidal prism appears to be quite large but the movement of water once outside the inlets is not very rapid. The waters are not moving away from the coastline but rather along the coast.

N73-20350* Environmental Research Inst. of Michigan, Ann Arbor.

TASK 1: WATER DEPTH MANAGEMENT, 1388

Fabian C. Polcyn, Principal Investigator In its Process. and Analysis of ERTS-1 Remotely Sensed Data 15 Mar. 1973 8 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(E73-10388) CSCL 08C

The author has identified the following significant results. ERTS-1 MSS data taken on October 10, 1972, of the Little Bahama Bank are being used to demonstrate the use of ERTS-1 data for mapping of shallow water features for the purpose of upgrading world navigation charts. Marked reflectance differences occur for the shallow water areas in bands 4, 5, and 6. Digital processing of two adjacent data tapes within the ERTS-1 frame covering an area of about 40 by 40 miles has been completed. Correlation of depth measurements to 5 meters has been successful. A mathematical model for depth measurements using ratio of voltages in band 4 and 5 has been successfully developed and is being tested for accuracy. Additional studies for areas near Puerto Rico and in northern Lake Michigan will be undertaken. Satellite data will also provide geographical evidence for verifying existence or nonexistence of doubtful shoal waters now appearing on world charts and considered to be hazardous to shipping.

N73-20353* Environmental Research Inst. of Michigan, Ann Arbor.

TASK 4: LAKE ICE SURVEILLANCE, 1406

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L. Porcello, Principal Investigator and M. L. Bryan *In its Process.*
and Analysis of ERTS-1 Remotely Sensed Data 15 Mar. 1973
7 p
(E73-10391) CSDL 08L

The author has identified the following significant results. Although it is readily recognized that there is a need for ground truth to provide adequate guidance for remote sensing data interpretation, it is noted that, in terms of radar remote sensing, this ground truth is often inadequate. It is necessary to make basic electrical and physical measurements of the surface and to some depth below it. A brief outline is presented of a ground truth scheme which uses measurements of the dielectric constant. Two portable instruments were designed specifically for this purpose; these were: (1) a Q-meter for measurement of dielectric constant and loss tangent; and (2) an instrument to measure electrical properties of the two operating frequencies of the imaging radar. Although extensive data are lacking, several general cases of radar-earth surface and interaction are described; also, examples of radar imagery and some data on ice and snow are presented. It is concluded that the next logical step is to begin to quantify the radar ground truth in preparation for machine interpretation and automatic data processing of the radar imagery.

N73-20364*# Alaska Univ., Fairbanks.
CIRCULATION OF PRINCE WILLIAM SOUND Bimonthly
Progress Report
Robin D. Muench, Principal Investigator 31 Mar. 1973 2 p
(Contract NAS5-21833)
(E73-10402; NASA-CR-131138; BMPR-4) Avail: NTIS HC \$3.00 CSDL 08C

N73-20374*# Geological Survey, Menlo Park, Calif.
**COASTAL ENVIRONMENT OF THE BEAUFORT SEA FROM
FIELD DATA AND ERTS-1 IMAGERY, SUMMER 1972**
Progress Report, 1 Jul. - 31 Dec. 1972
Erk Reimnitz, Principal Investigator and Peter W. Barnes 31 Dec.
1972 22 p refs Original contains imagery. Original photography
may be purchased from the EROS Data Center, 10th and Dakota
Avenue, Sioux Falls, S. D. 57198
(NASA Order S-70243-AG)
(E73-10412; NASA-CR-131148) Avail: NTIS HC \$3.25 CSDL
08C

The author has identified the following significant results. An extensive field program during the spring and summer in the coastal Beaufort Sea test site has been completed using a wide variety of sensing techniques. Reduction of field data and ERTS-1 image analysis have shown the coastal environment to be complexly influenced by unique processes, most of which involve or are related to sea ice. Active sedimentologic processes along the Arctic coast are set in motion by the melting, flooding, and eventual overflow of rivers onto the sea ice. It is now apparent that only minor amounts of sediment are transported offshore at this stage; however, scouring of the bottom is significant beneath the strudels (drain holes) which develop in the fast ice canopy in the region of overflow. Areal salinity and turbidity patterns together with ERTS-1 imagery confirm a consistent influx of colder, clearer, saltier water towards the coast just east of the Colville River. Strong (up to 3 knots) bidirectional but intermittent currents often manifest themselves in imagery and aerial photographs as wakes behind grounded ice. Ice movement vectors generated from repetitive images indicate that ice drift is closely associated with wind direction, especially in shallow bays, and displacements of 4-22 kilometers were noted in 24 hours.

N73-20378*# Alaska Univ., Fairbanks.
**SEA ICE AND SURFACE WATER CIRCULATION, ALASKAN
CONTINENTAL SHELF** Bimonthly Progress Report
Frederick F. Wright, Principal Investigator, G. D. Sharma, and J.
J. Burns 29 Mar. 1973 18 p Original contains imagery.
Original photography may be purchased from the EROS Data
Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
(Contract NAS5-21833)
(E73-10416; NASA-CR-131154; BMPR-4) Avail: NTIS HC
\$3.00 CSDL 08L

The author has identified the following significant results. Sediments contributed by the Copper River in the Gulf of Alaska are carried westward along the shore as a distinct plume. Oceanic water relatively poor in suspended material appears to intrude near Montague Island, and turbid water between Middleton Island and Kayak Island is the result of Ekman between transport. An anticlockwise surface water circulation is observed in this region. Ground truth data indicate striking similarity with ERTS-1 imagery obtained on October 12, 1972. Observations of ERTS-1 imagery reveal that various characteristics and distribution of sea ice in the Arctic Ocean can be easily studied. Formation of different types of sea ice and their movement is quite discernible. Sea ice moves parallel to the coast in near shore areas and to the northerly direction away from the coast.

N73-20385*# Old Dominion Univ. Research Foundation, Norfolk, Va.
**INVESTIGATION TO RELATE CHLOROPHYLL AND SUS-
PENDED SEDIMENT CONTENT IN WATERS OF LOWER
CHESAPEAKE BAY TO ERTS-1 IMAGERY** Semiannual
Report, 4 Aug. 1972 - 31 Jan. 1973
Peter Fleischer 31 Jan. 1973 6 p
(Contract NAS5-21816)
(E73-10424; NASA-CR-131214) Avail: NTIS HC \$3.00 CSDL
08A

N73-20387*# Delaware Univ., Newark. Coll. of Marine Studies.
**APPLICATION OF ECOLOGICAL, GEOLOGICAL AND
OCEANOGRAPHIC ERTS-1 IMAGERY TO DELAWARE'S
COASTAL RESOURCES PLANNING** Progress Report, Jan. -
Feb. 1973
V. Klemas 29 Mar. 1973 7 p refs
(Contract NAS5-21837)
(E73-10426; NASA-CR-131216) Avail: NTIS HC \$3.00 CSDL
08A

The author has identified the following significant results. Communities containing four different coastal vegetation species, developed marshlands, and fresh water impoundments have been identified in ERTS-1 images. Ground measurements of suspended sediment load have been correlated with tonal variations in band 5.

N73-20407*# Environmental Research and Technology, Inc.,
Lexington, Mass.
**MAPPING ARCTIC SEA ICE FROM THE EARTH RESOURC-
ES TECHNOLOGY SATELLITE**
James C. Barnes, Principal Investigator and Clinton J. Bowley
9 Apr. 1973 19 p refs Submitted for publication Original
contains imagery. Original photography may be purchased from
the EROS Data Center, 10th and Dakota Avenue, Sioux Falls,
S. D. 57198
(Contract NAS5-21802)
(E73-10447; NASA-CR-131242) Avail: NTIS HC \$3.00 CSDL
08L

The author has identified the following significant results. Methods of detecting ice and for distinguishing between ice and clouds are discussed, and examples of ERTS-1 data showing ice distributions in northern Hudson Bay, McClure Strait, the eastern Beaufort Sea, and the Greenland Sea are presented. The results of the initial analysis of ERTS-1 data indicate that the locations of ice edges and ice concentrations can be accurately mapped, and that considerable information on ice type can be derived through use of the various spectral bands. Ice features as small as 80 to 100 m width can be mapped.

N73-20443# TRW Systems Group, Redondo Beach, Calif.
Theoretical Physics Group.
**ANALYTICAL STUDY OF MICROWAVE SEA BRIGHTNESS
TEMPERATURES: A COMPOSITE SURFACE MODEL** Final
Report
Richard J. Wagner and Philip J. Lynch Dec. 1972 84 p refs
(Contract N00014-71-C-0240; NR Proj. 387-051)
(AD-753533; TRW-17608-6010-RQ-00) Avail: NTIS CSDL
08/10

The second-order geometrical optics theory of rough surface emissivity and sea brightness temperatures is extended to lower microwave frequencies by the introduction of a composite surface model, in which the diffraction effects of surface structure smaller than a wavelength are explicitly included. Sea brightness temperatures are calculated for a range of microwave frequencies, both polarizations, all observation angles, and a variety of environmental parameters. The results are in good agreement with experiment. Author (GRA)

N73-20450# Avco-Everett Research Lab., Everett, Mass.
SEAWATER TEMPERATURE MEASUREMENT FROM RAMAN SPECTRA Interim Technical Report
Chin H. Chang and Lee A. Young Dec. 1972 52 p
(Contract N62269-73-C-0073; ARPA Order 2194)
(AD-753481) Avail: NTIS CSCL 08/10

Raman spectra of water have been measured in the laboratory using improved optical instrumentation. The linear depolarization ratio agrees well with results found in the literature. Various portions of the isotropic and anisotropic components of the Raman spectra can be identified with distinct structural species in liquid water. The model predicts that the depolarization will be most temperature dependent in the long-wavelength portion of the spectrum, as is demonstrated by the data. Author (GRA)

N73-21317*# Earth Satellite Corp., Washington, D.C.
INVESTIGATION TO IMPROVE MENHADEN FISHERY PREDICTION Progress Report, 11 Feb. - 10 Apr. 1973
Paul M. Maughan, Principal Investigator 9 Apr. 1973 3 p ERTS
(Contract NAS5-21743)
(E73-10480; NASA-CR-131300) Avail: NTIS HC \$3.00 CSCL 08A

N73-21323*# Geological Survey, Menlo Park, Calif.
PRINCIPAL SOURCES AND DISPERSAL PATTERNS OF SUSPENDED PARTICULATE MATTER IN NEARSHORE SURFACE WATERS OF THE NORTHEAST PACIFIC OCEAN AND THE HAWAIIAN ISLANDS Progress Report, 1 Sep. 1972 - 1 Mar. 1972
Paul R. Carlson, Principal Investigator, T. John Conomos, Richard J. Janda, and David H. Peterson 2 Apr. 1973 9 p ERTS
(NASA Order S-70243-AG-7)
(E73-10487; NASA-CR-131307) Avail: NTIS HC \$3.00 CSCL 08C

The author has identified the following significant results. ERTS-1 multispectral scanner imagery of the nearshore surface waters of the Northeast Pacific Ocean is proving to be a useful tool for determining source and dispersal of suspended particulate matter. The principal sources of the turbid water, seen best on the green and red bands, are river and stream effluents and actively eroding coastlines; secondary sources are waste effluents and production of planktonic organisms, but these may sometimes be masked by the very turbid plumes of suspended sediment being discharged into the nearshore zone during times of high river discharge. The configuration and distribution of the plumes of turbid water also can be used to infer near-surface current directions. Comparison of imagery of the nearshore water off the northern California coast from October 1972 and January 1973 shows a reversal of the near-surface currents, from predominantly south-setting in the fall (California Current) to north-setting in the winter (Davidson Current).

N73-21328*# Geological Survey, Menlo Park, Calif.
STUDIES OF THE INNER SHELF AND COASTAL SEDIMENTATION ENVIRONMENT OF THE BEAUFORT SEA FROM ERTS-1 Progress Report, 1 Jan. - 1 Mar. 1973
Erk Reimnitz, Principal Investigator and Peter W. Barnes 30 Mar. 1973 7 p refs ERTS
(NASA Order S-70243-AG)
(E73-10492; NASA-CR-131312) Avail: NTIS HC \$3.00 CSCL 08C

The author has identified the following significant results. Northward flowing rivers of Alaska inundate extensive areas of

sea ice during spring breakup. This process has been studied under the ERTS-1 program. Drainage of large volumes of fresh water through the ice at holes and cracks (strudel) causes scour depressions, over 4 m deep, and up to 20 m across in the sea floor below. Strudel scours occur within 30 km of river mouths, generally in areas where ERTS-1 imagery shows less potential for drifting ice to scour the bottom than elsewhere. The shapes and distribution patterns of strudel scours correspond with those of strudel seen in the ice canopy. Densities of scours are highest in the inner areas of overflow. But strudel scours also occur outside of overflow areas mapped during the last several years. These must be very old. One strudel scour investigated by diving is surrounded by a rim, has vertical walls exposing a tundra horizon, and terminates at a gravel layer 4 m below the lagoon floor. Another terminates at a semi-consolidated layer of silty clay. The gravel and silty clay are pre-Holocene deposits. Mixing of Holocene marine with older sediments by vertical strudel flow causes great variability in sediment types over small areas. These observations complicate interpretation of shallow water deposits of cold climates.

N73-21363# Joint Publications Research Service, Arlington, Va.
UNITED STATES' FORECASTS FOR THE STUDY AND EXPLORATION OF THE WORLD OCEAN
V. D. Pisarev 10 Apr. 1973 14 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. V: Geograf (Moscow), Jan. - Feb. 1973 p 19-27
(JPRS-58696) Avail: NTIS HC \$3.00

The possible use of scientific, industrial, and military equipment to broaden the possibilities of oceanological investigations is discussed. The use of such equipment for exploitation of resources, strategic areas, and ocean floors and depths is also covered.

Author

N73-21378# North American Rockwell Corp., Downey, Calif.
Space Div.
A MONOGRAPH ON APPLICATIONS OF MULTICOLOR DYE TRACERS AND MULTISPECTRAL PHOTOGRAPHY TO COASTAL WATER MAPPING
David T. Hodder Mar. 1972 26 p refs
(Contract N00014-72-C-0149)
(AD-754437; SD-72-SA-0071) Avail: NTIS CSCL 08/3

A new concept has been evolved for investigation of the morphology and 3-D transport of turbidity cells. The basic idea is to make use of the variable extinction (water penetration) depths for different bandwidths (plus or minus 100A) of the image forming light scattered through relatively turbid waters, and the narrow band slicing of the visible spectrum feasible with interference filters. The method of employing these phenomena and multiband imaging techniques is to make a multicolored dye release of dyes with characteristic spectral signatures as viewed with narrow band (interference) filters. These releases are to be made at depths which match the extinction depths for light in the respective dye characteristic signature bandwidths. The resulting dye patches are then imaged through narrow band interference filters matched to the characteristic spectral signature and extinction depths for each type of dye.

Author (GRA)

N73-22292*# Army Engineer Command, Vietnam, APO San Francisco, Calif. 96491
CALIFORNIA COAST NEARSHORE PROCESSES STUDY Progress Report, 1 Mar. - 30 Apr. 1973
Douglas M. Pirie, Principal Investigator and David D. Steller (Rockwell Intern. Corp., Downey, Calif.) May 1973 7 p ERTS
(NASA Order S-70257-AG)
(E73-10525; NASA-CR-131492; ERTS-1-I-3) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. Remote sensor aircraft flights took place simultaneously with ERTS-1 overpasses at the San Francisco, Monterey Bay, and Santa Barbara test cells. The cameras and scanners used were configured for detecting suspended sediment and for maximum water penetration. The Ektachrome/Wratten 12 photographs

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which were intentionally overexposed 1-1/2 stops were found to show the most extensive sediment transport detail. Minus blue/K 2 photographs illustrate nearshore underwater bottom detail including the head of the Mugu submarine canyon. The EMSIDE 9 channel scanner was employed to classify and differentiate suspended sediment, oil, kelp, and other materials found in the nearshore area. Processing of bulk ERTS-1 computer compatible tapes was utilized to enhance and analyze nearshore sediments. This technique was most successful in enhancing subtle nearshore features found to be faint or invisible on prints made from the supplied negatives. In addition to this continuing computer process, an effort was initiated to interface density values from the bulk tapes into contouring and mapping software.

N73-22295* Research Triangle Inst., Durham, N.C.
CORRELATION OF OCEAN SURFACE PARAMETERS WITH RADAR BACKSCATTERING DATA AND THEORY Monthly Progress Report, 8-31 Mar. 1973
Lee S. Miller and Gary S. Brown, Principal Investigators 19 Apr. 1973 2 p EREP
(Contract NAS9-13304)
(E73-10530; NASA-CR-131595) Avail: NTIS HC \$3.00 CSCL 08C

N73-23207* Ecole Pratique des Hautes Etudes, Paris (France).
MARSHES AND TURBID WATERS IN THE FRENCH ATLANTIC LITTORAL Progress Report, Mar. - Apr. 1973; Fernand Verger, Principal Investigator May 1973 4 p Sponsored by NASA ERTS
(E73-10548; NASA-CR-131652) Avail: NTIS HC \$3.00 CSCL 08H

N73-23410* Delaware Univ., Newark. Coll. of Marine Studies.
APPLICATION OF ECOLOGICAL, GEOLOGICAL AND OCEANOGRAPHIC ERTS-1 IMAGERY TO DELAWARE'S COASTAL RESOURCES PLANNING
V. Klemas, Principal Investigator and D. Bartlett 13 Feb. 1973 4 p ERTS
(Contract NAS5-21837)
(E73-10516; NASA-CR-131477) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. Coastal vegetation species appearing in the ERTS-1 images taken of Delaware Bay have been correlated with ground truth vegetation maps and imagery obtained from high altitude overflights. Multispectral analysis of the high altitude photographs indicated that four major vegetation communities could be clearly discriminated from 60,000 feet altitude including: (1) salt marsh cord grass; (2) salt marsh hay and spike grass; (3) reed grass; and (4) high tide bush and sea myrtle. In addition, human impact can be detected in the form of fresh water impoundments built to attract water fowl, dredge-fill operations and other alterations of the coastal environment. Overlay maps matching the USGS topographic map size of 1:24,000 have been prepared showing the four wetland vegetation communities, fresh water impoundments, and alteration of wetlands by mosquito control ditching and dredge-fill operations. Using these maps, ERTS-1 images were examined by human interpreters and automated multispectral analyzers. Major plant communities of (1) *Spartina alterniflora*, (2) *Spartina patens* and *Distichlis spicata*, and (3) *Iva frutescens* and *Baccharis halimifolia* can be distinguished from each other and from surrounding uplands in ERTS-1 scanner bands 6 and 7.

N73-23423* Arizona Univ., Tucson. Dept. of Biological Sciences.
STUDY OF THE MARINE ENVIRONMENT OF THE NORTHERN GULF OF CALIFORNIA Progress Report, period ending 30 Apr. 1973
J. R. Hendrickson, Principal Investigator 30 Apr. 1973 7 p ERTS
(Contract NAS5-21777)
(E73-10550; NASA-CR-131849) Avail: NTIS HC \$3.00 CSCL

N73-23441* National Marine Fisheries Service, Bay Saint Louis, Miss.

RELATIONSHIPS BETWEEN REMOTELY SENSED FISHERIES DISTRIBUTION INFORMATION AND SELECTED OCEANOGRAPHIC PARAMETERS IN THE MISSISSIPPI SOUND

Andrew J. Kemmerer and Joseph A. Benigno 9 Mar. 1973 11 p refs Presented at ERTS-1 Symp., New Carrollton, 5-9 Mar. 1973 Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
(NASA Order S-70246-AG)
(E73-10580; NASA-CR-131884) Avail: NTIS HC \$3.00 CSCL 08J

The author has identified the following significant results. A feasibility study to demonstrate the potential of satellites for providing fisheries significant information was conducted in the Mississippi Sound and adjacent offshore waters. Attempts were made to relate satellite acquired imagery to selected oceanographic parameters and then to relate these parameters to aircraft remotely sensed distribution patterns of resident surface schooling fishes. Initial results suggest that this approach is valid and that the satellite acquired imagery may have important fisheries resource assessment implications.

N73-23451* National Oceanic and Atmospheric Administration, Miami, Fla. Environmental Research Labs.
REMOTE DETECTION OF OCEANIC EDDIES IN THE LESSER ANTILLES USING ERTS-1 DATA Progress Report
Kirby J. Hanson, Principal Investigator 4 Dec. 1972 2 p ERTS
(NASA Order S-70246-AG-1)
(E73-10592; NASA-CR-131808) Avail: NTIS HC \$3.00 CSCL 13C

N73-23452* Environmental Research and Technology, Inc., Lexington, Mass.

EVALUATE THE APPLICATION OF ERTS-A DATA FOR DETECTING AND MAPPING SEA ICE Bimonthly Progress Report, 28 Feb. - 10 May 1973

James C. Barnes, Principal Investigator 24 May 1973 9 p ERTS

(Contract NAS5-21802)
(E73-10595; NASA-CR-131811; ERT-P-408-5; BMRP-4) Avail: NTIS HC \$3.00 CSCL 08L

The author has identified the following significant results. Generally good agreement has been observed between the location of ice edges and ice concentrations as indicated on serial observation charts and as mapped from ERTS-1 imagery. Moreover, ice surface features reported to be ridges and thaw holes are readily detected in the ERTS-1 imagery. Reported hummocks, puddles, frozen puddles, and rafted ice are not as readily detected in the imagery, although brightness variations on some ice surfaces can be distinguished, thereby suggesting their presence. In the ERTS-1 imagery, although dark new ice and nilas are difficult to detect, other younger forms of ice can be mapped and can usually be distinguished from older ice because of their lower, more uniform reflectance. A preliminary examination of the initial sample of ERTS-1 imagery collected during the spring, during the season of maximum ice extent, indicates several ice features of interest. Compact pack ice can be distinguished from coastal fast ice, and many leads can be mapped, even in the mid-Beaufort Sea. Several leads have distinct variation in reflectance.

N73-23507* Louisiana State Univ., Baton Rouge. Coastal Studies Inst.

PERIODICITIES IN INTERFACIAL MIXING

Lynn D. Wright, James M. Coleman, and Joseph N. Suhayda Jan. 1973 12 p refs Repr. from Coastal Studies, Bull. 7, Jan. 1973 p 127-135

(Contract N00014-69-A-0211-0003; NR Proj. 388-002)
(AD-755158; TR-133) Avail: NTIS CSCL 08/8

Freshwater effluents from river outlets spread and diffuse into ambient marine water; the interactions which take place between these water masses at and immediately seaward of the river mouth are critical in controlling the dissemination of sediment and water transported by the river. Mixing between these water masses, each characterized by differing properties, takes place in many ways and is affected by various mechanisms. These mechanisms control the outflow patterns and hence fundamentally determine the pattern of sediment dissemination, accumulation, and distribution of the bars that form at river mouths. Thus greater understanding of the behavior of the effluent plume would significantly aid charting, navigation, and similar operations in these constantly changing areas of strategic importance. The paper uses various remote-sensing techniques to analyze the behavior of the river plume under varying conditions. Author (GRA)

N73-24346* Environmental Research Inst. of Michigan, Ann Arbor.

WATER DEPTH MEASUREMENT, TASK 1
F. C. Polcyn, Principal Investigator. In its ERTS-1 Invest. conducted by Environ. Res. Inst. of Mich. 9 May 1973 1 p ERTS

(E73-10666) CSCL 08J

N73-24356* Old Dominion Univ. Research Foundation, Norfolk, Va.

INVESTIGATION TO RELATE THE CHLOROPHYLL A-D SUSPENDED SEDIMENT CONTENT IN THE WATERS OF THE LOWER CHESAPEAKE BAY TO ERTS-1 IMAGERY, TASK 2. THE USE OF ERTS-1 TO MORE FULLY UTILIZE AND APPLY MARINE STATION DATA TO THE STUDY OF PRODUCTIVITY ALONG THE EASTERN SHELF EXPANDED WATERS OF THE UNITED STATES Bimonthly Report, 1 Feb. - 31 Mar. 1973

John C. Ludwick, Principal Investigator, H. G. Marshall, Fleischer, Hanna, Gosink, and Bowker 31 Mar. 1973 3 p ERTS
(Contract NAS5-21816)

(E73-10693; NASA-CR-131808) Avail: NTIS HC \$3.00 CSCL 08A

N73-24365* Science Applications, Inc., Ann Arbor, Mich.
USE OF SKYLAB EREP DATA IN A SEA SURFACE TEMPERATURE EXPERIMENT Quarterly Report, 17 Feb. - 17 May 1973

David C. Anding, Principal Investigator May 1973 24 p refs EREP

(Contract NAS9-13277)
(E73-10604; NASA-CR-132000; QR-1) Avail: NTIS HC \$3.25 CSCL 08J

The author has identified the following significant results. This report discusses an experiment to be performed on each of the three manned Skylab missions, the results of which will assess the ability of spaceborne infrared multispectral sensing to function as a means of providing improved estimates of sea surface temperature over that obtainable with a single channel radiometric instrument. The overall investigative program is outlined, the effort performed during the prelaunch phase is detailed, and pertinent results are presented.

N73-24373* National Oceanic and Atmospheric Administration, Miami, Fla. Atlantic Oceanographic and Meteorological Labs.
REMOTE SENSING OF OCEAN CURRENTS Interim Report, Nov. 1972 - May 1973

George A. Maul, Principal Investigator May 1973 26 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(NASA Order S-70246-AG)

(E73-10612; NASA-CR-132009) Avail: NTIS HC \$3.50 CSCL

08C

The author has identified the following significant results. Monthly field experiments in support of the NOAA investigation of ocean color boundary determination using ERTS-1 data have been conducted since June 1972. The boundary between coastal waters and the Loop Current has been detected by ERTS-1 as a result of sea state changes as well as color differences. Ocean information is contained in all 24 channels of the Bendix MSS flown on the C-130 in June 1972; this includes UV, visible, reflected IR, and emitted IR. Computer enhancement of MSS data is revealing many features not shown in the NDFP product.

N73-24378* Alaska Univ., Fairbanks.
CIRCULATION OF PRINCE WILLIAM SOUND Bimonthly Progress Report

Robin D. Muench, Principal Investigator 31 May 1973 2 p ERTS

(Contract NAS5-21833)
(E73-10617; NASA-CR-132028; BMPR-5) Avail: NTIS HC \$3.00 CSCL 08C

N73-24381* Alaska Univ., Fairbanks.
SEA ICE AND SURFACE WATER CIRCULATION, ALASKAN CONTINENTAL SHELF Bimonthly Progress Report

Frederick F. Wright, Principal Investigator, G. D. Sharma, and J. J. Burn 30 May 1973 8 p refs ERTS

(Contract NAS5-21833)
(E73-10620; NASA-CR-132031; BMPR-5) Avail: NTIS HC \$3.00 CSCL 08C

The author has identified the following significant results. The boundaries of land-fast ice, distribution of pack ice, and major polynya were studied in the vicinity of the Bering Strait. Movement of pack ice during 24 hours was determined by plotting the distinctly identifiable ice floes on ERTS-1 imagery obtained from two consecutive passes. Considerably large shallow area along the western Seward Peninsula just north of the Bering Strait is covered by land fast ice. This ice hinders the movement of ice formed in eastern Chukchi Sea southward through the Bering Strait. The movement of ice along the Russian coast is relatively faster. Plotting of some of the ice floes indicated movement of ice in excess of 30 km in and south of the Bering Strait between 6 and 7 March, 1973. North of the Bering Strait the movement approached 18 km. The movement of ice observed during March 6 and 7 considerably altered the distribution and extent of polynya. These features when continually plotted should be of considerable aid in navigation of ice breakers. The movement of ice will also help delineate the migration and distribution of sea mammals.

N73-24384* National Marine Fisheries Service, Bay Saint Louis, Miss. Fisheries Engineering Lab.

INVESTIGATION USING DATA FROM ERTS TO DEVELOP AND IMPLEMENT UTILIZATION OF LIVING MARINE RESOURCES Interim Report, 1 Jul. 1972 - 10 Mar. 1973
William H. Stevenson, Principle Investigator and Edward J. Pastula, Jr. Jun. 1973 19 p ERTS

(NASA Order S-70246-AG)
(E73-10624; NASA-CR-132035) Avail: NTIS HC \$3.00 CSCL 08A

The author has identified the following significant results. A feasibility study to demonstrate the potential of satellites for providing fisheries significant information was conducted in the Mississippi Sound and adjacent offshore waters. Attempts were made to relate satellite acquired imagery to selected oceanographic parameters and then to relate these parameters to aircraft remotely sensed distribution patterns of resident surface schooling fishes. Initial results suggest that this approach is valid and that the satellite acquired imagery may have important fisheries resource assessment implications.

N73-24391* Delaware Univ., Newark. Coll. of Marine Studies.
APPLICATION OF ECOLOGICAL, GEOLOGICAL AND

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OCEANOGRAPHIC ERTS-1 IMAGERY TO DELAWARE'S COASTAL RESOURCES PLANNING Progress Report, Apr. - Jun. 1973

V. Klemas, Principal Investigator 8 Jun. 1973 7 p ERTS
(Contract NAS5-21837)
(E73-10631; NASA-CR-132042) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. Communities containing five different coastal vegetation species, developed marshlands, and fresh water impoundments have been identified in ERTS-1 images. Suspended sediment and circulation patterns in imagery from five ERTS-1 passes over Delaware Bay have been enhanced and correlated with predicted current patterns. Conclusions reached are: (1) ERTS-1 is suitable platform for observing suspended sediment patterns and water masses synoptically over large areas. (2) Suspended sediment acts as a natural tracer allowing photointerpreters to deduce gross current circulation patterns from ERTS-1 imagery. (3) Under atmospheric conditions encountered along the East Coast of the United States MSS band 5 seems to give the best representation of sediment load in upper one meter of water column. (4) In the ERTS-1 imagery the sediment patterns are delineated by three to four neighboring shades of grey. (5) Negative transparencies of the ERTS-1 images give better contrast whenever the suspended sediment tones fall within the first few steps of the grey scale. (6) Color density slicing helps delineate the suspended sediment patterns more clearly and differentiate turbidity levels.

N73-24424# Oregon State Univ., Corvallis.

MULTISPECTRAL SCANNER STUDIES OF THE OCEAN OFF THE OREGON COAST

[1973] 67 p refs
Avail: NTIS HC \$5.50

Analysis of multispectral scanner data from flight lines off the Oregon coast during the summer of 1969 revealed changes in radiance of backscattered light that were related to upwelling, the Columbia River plume, and oceanic water. Cold, upwelled water was usually green, presumably because of high phytoplankton concentrations. Differences between blue and green radiances (channels 2 and 4) were small (0.1 or less) and between 4 and 6 (green and orange-red) were large. Upwelled water was also spectrally variable probably because of the biological changes that occur during the aging and offshore advection of this water.

Author

N73-26336# Army Engineer Waterways Experiment Station, Vicksburg, Miss.

SEDIMENT PATTERN CORRELATION WITH INFLOW AND TIDAL ACTION Progress Report

Warren E. Grabau, Principal Investigator 6 Jun. 1973 5 p ERTS

(NASA Order S-70259-AG)
(E73-10623; NASA-CR-132034) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. At the time the two scenes of the Chesapeake Bay Study Area were taken, ground truth data were taken at a number of stations within each of the test areas. Where local conditions permitted, either all or a part of the following parameters were measured: water temperature, spectral transmittance, conductivity, turbidity, dissolved oxygen, current velocity, and pH. In addition, a sample of water was taken at each location and the concentration of suspended material in each sample was determined. In the analysis the relationship of each measured parameter and the corresponding radiance values (reflectance spectrum) detected by the ERTS-1 were evaluated. Thus far, the analysis has shown a good correlation with concentrations of suspended material contained in the water.

N73-26345# Geological Survey, Menlo Park, Calif.

STUDIES OF THE INNER SHELF AND COASTAL SEDIMENTATION ENVIRONMENT OF THE BEAUFORT SEA FROM

ERTS-1 Progress Report, 1 Mar. - 1 May 1973

Erk Reimnitz, Principal Investigator and Peter W. Barnes 31 Mar. 1973 6 p refs ERTS

(NASA Order S-70243-AG)

(E73-10649; NASA-CR-132240) Avail: NTIS HC \$3.00 CSCL 08J

The author has identified the following significant results. The particulate transport processes involved in the movement of surficial waters were examined using secchi disc readings, light attenuation coefficients, and particulate weights from filtration. Observations gathered during the summers of 1971 and 1972 indicate a remarkable difference in particulate matter and turbidity between the two years. ERTS-1 imagery during August 1972 showed turbid water along the northern Alaska coast. The uniformity of distribution of the turbid water and the fact that the river discharge is low at this period suggest that the turbidity is related to causes other than river effluent. Studies indicate that wave action is a more significant factor influencing particulate transport than believed heretofore. The boundary between the essentially immobile shorefast ice and the moving pack ice has been plotted from several ERTS-1 images and found to occur fairly consistently along the 20 meter contour. Considering the vast difference in the amount of ice movement shoreward and seaward of this boundary, ice-bottom action should also be different on either side of this boundary and for that matter at the shear zone that develops along the boundary.

N73-25354# National Marine Fisheries Service, Bay Saint Louis, Miss.

APPLICATION OF REMOTE SENSING FOR FISHERY RESOURCE ASSESSMENT AND MONITORING. Monthly Progress Report, 1 May - 8 Jun. 1973

William H. Stevenson, Principal Investigator 12 Jun. 1973 5 p EREP

(NASA Order T-8217-B)

(E73-10658; NASA-CR-132249; HPR-2) Avail: NTIS HC \$3.00 CSCL 08A

N73-25358# Army Engineer Waterways Experiment Station, Vicksburg, Miss.

MOVEMENT OF SUSPENDED PARTICLE AND SOLUTE CONCENTRATIONS WITH INFLOW AND TIDAL ACTION Interim Report, Aug. 1972 - Feb. 1973

A. N. Williamson Feb. 1973 19 p ref ERTS

(NASA Order S-70259-AG)

(E73-10662; NASA-CR-132171) Avail: NTIS HC \$3.00 CSCL 08J

N73-25371# National Aeronautics and Space Administration Lyndon B. Johnson Space Center, Houston, Tex.

ANALYSIS OF USEFULNESS OF ERTS-1 MSS DATA IN DETECTING AND MEASURING COASTAL MARSHES

R. Bryan Erb, Principal Investigator [1973] 1 p ERTS

(E73-10676; NASA-TM-X-69265) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. The usefulness of ERTS-1 data in detecting and measuring coastal marshes has been analyzed. The data chosen for study was taken over the Houston Area Test Site on August 29, 1972. A study site was selected which contained marshes of varying size. Using a computerized clustering algorithm which groups areas of spectral homogeneity, it was possible to distinguish twenty-five classes or features. To determine the total acreage of the marshes, the pure picture elements were counted. Using a technique developed by the team, the boundary picture elements were also counted. Ground truth was provided from rectified, enlarged, and scaled high altitude aircraft photography acquired during the same time frame. Comparison of the ground truth coverage depicted by the aircraft photography to the clustering acreage displayed from the ERTS-1 data showed a percentage of accuracy ranging from 89% to 99% for determining areal extent of coastal marshes.

N73-25372* National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, Tex.
EDITING ERTS-1 DATA TO EXCLUDE LAND AIDS CLUSTER ANALYSIS OF WATER TARGETS
 R. Bryan Erb, Principal Investigator [1973] 1 p ERTS
 (E73-10677; NASA-TM-X-69266) Avail: NTIS HC \$3.00 CSCL 05B

The author has identified the following significant results. It has been determined that an increase in the number of spectrally distinct coastal water types is achieved when data values over the adjacent land areas are excluded from the processing routine. This finding resulted from an automatic clustering analysis of ERTS-1 system corrected MSS scene 1002-18134 of 25 July 1972 over Monterey Bay, California. When the entire study area data set was submitted to the clustering only two distinct water classes were extracted. However, when the land area data points were removed from the data set and resubmitted to the clustering routine, four distinct groupings of water features were identified. Additionally, unlike the previous separation, the four types could be correlated to features observable in the associated ERTS-1 imagery. This exercise demonstrates that by proper selection of data submitted to the processing routine, based upon the specific application of study, additional information may be extracted from the ERTS-1 MSS data.

N73-25380* RAND Corp., Santa Monica, Calif.
APPLICABILITY OF ERTS FOR SURVEYING ANTARCTIC ICEBERG RESOURCES Progress Report, Feb. - Apr. 1973
 John L. Hult, Principal Investigator and Neill C. Ostrander Apr. 1973 5 p ERTS
 (Contract NAS5-21905)
 (E73-10686; NASA-CR-132193) Avail: NTIS HC \$3.00 CSCL 08L

The author has identified the following significant results. Recognition and interpretation of icebergs proves to be easy when they are locked in sea or fast ice. They stand out in relief, particularly well in band 7. Recognition of isolated icebergs is much more difficult. Size, shape, interaction with sea ice, and change over time must then be used to help in positive identification. There seems to be much less current and relative motion between icebergs and sea in much of the test sector than had been believed from available exploration information. However, most of this type of assessment must await the accumulation and analysis of the full season data.

N73-25385* RAND Corp., Santa Monica, Calif.
APPLICABILITY OF ERTS FOR SURVEYING ANTARCTIC ICEBERG RESOURCES Progress Report, May - Jun. 1973
 John L. Hult, Principal Investigator and Neill C. Ostrander Jun. 1973 5 p ERTS
 (Contract NAS5-21095)
 (E73-10692; NASA-CR-132981) Avail: NTIS HC \$3.00 CSCL 08L

N73-25398* National Marine Fisheries Service, Bay Saint Louis, Miss. Fisheries Engineering Lab.
INVESTIGATION USING DATA FROM ERTS TO DEVELOP AND IMPLEMENT UTILIZATION OF LIVING MARINE RESOURCES Progress Report, 20 Jan. - 20 Jul. 1973
 William H. Stevenson, Principal Investigator and Edward J. Pastula, Jr. Jul. 1973 18 p refs ERTS
 (NASA Order S-70246-AG)
 (E73-10707; NASA-CR-133020) Avail: NTIS HC \$3.00 CSCL 08A

The author has identified the following significant results. The feasibility of utilizing ERTS-1 data in conjunction with aerial remote sensing and sea truth information to predict the distribution of menhaden in the Mississippi Sound during a specific time frame has been demonstrated by employing a number of uniquely designed empirical regression models. The construction of these models was made possible through innovative statistical routines specifically developed to meet the stated objectives.

N73-25412* Naval Research Lab., Washington, D.C. Aerospace Radar Branch.
DETERMINATION OF OCEAN SURFACE DESCRIPTORS USING SEA PHOTO ANALYSIS TECHNIQUES Final Report on Phase 1, Apr. 1971 - Aug. 1972
 R. O. Pilon FAA Oct. 1972 53 p refs
 (Contract DOT-FA71WAI-220)
 (FAA-RD-72-110) Avail: NTIS HC \$4.75

The techniques of sea photo analysis have been utilized to obtain surface truth descriptors of the open ocean from an aircraft. Aerial photographs were taken in such a manner that the density fluctuations of the negatives were related to surface slope. The slope spectra, obtained by Fourier analysis of the negatives, were fitted to an equivalent form of the Pierson-Moskowitz wave height spectrum. The photographs, the wave height spectrum and the rms slope equations determined by Cox and Munk then yielded and averaged heading of the waves, the equivalent wind speed, the rms wave height and the rms slope for clean and slick surfaces. The optical techniques of sea photo analysis used in this program and digital analysis, used when whitecaps were present in the photographs, are discussed. The empirical equations used to determine rms wave height and slope and auxiliary rms slope and wave height spectrum equations are given. Author

N73-25454* Sparcom, Inc., Alexandria, Va.
LASER TRANSMISSION STUDIES OF EAST COAST WATERS
 A. H. Ghovanlou, G. D. Hickman, and J. E. Hogg Mar. 1973 42 p
 (Contract N00014-71-C-0202)
 (AD-759781; TR-2) Avail: NTIS CSCL 08/10

The transmission of a blue-green laser through waters representing several sites on the east coast of the United States were studied in the laboratory. The primary purpose of this investigation is to establish the capability of an airborne laser-detector system. Scattering transmission distributions of a collimated beam of light were measured in waters in which the turbidity was adjusted by a specific sediment. The turbidity of the waters was characterized by an attenuation coefficient which ranged from 0.07 - 2.0/m and an a/s ratio of 0.08 - 0.30. The reflectivity of the various sediments ranged from 2-20%. The results of the alpha/sediment loading data obtained for the various sediments show a close agreement with the results obtained for quartz. Author (GRA)

N73-26325* International Imaging Systems, Mountain View, Calif.
OCEAN WATER COLOR ASSESSMENT FROM ERTS-1 RBV AND MSS IMAGERY Progress Report, Dec. 1972 - Apr. 1973
 D. S. Ross, Principal Investigator 7 May 1973 11 p refs ERTS
 (Contract NAS5-21862)
 (E73-10718; NASA-CR-133218) Avail: NTIS HC \$3.00 CSCL 08J

N73-26332* International Imaging Systems, Mountain View, Calif.
OCEAN WATER COLOR ASSESSMENT FROM ERTS-1 RBV AND MSS IMAGERY Progress Report, 8 May - 7 Jul. 1973
 D. S. Ross, Principal Investigator 7 Jul. 1973 24 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
 (Contract NAS5-21862)
 (E73-10726; NASA-CR-133070) Avail: NTIS HC \$3.25 CSCL 08J

The author has identified the following significant results. Photo-optical and electronic density slicing were applied to ERTS-1 E 1007-151651-4, 30 July 1972, an area in the Caribbean showing deep ocean water, and shallow areas on the Great

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Baham Bank ranging from 0.5 meter or less to 18 meters. The density slicing processes were adjusted to correlate water radiance to bathymetric contours shown on C and GS Chart 1112. A number of large areas corresponding to water depths of 2 meters or less, 5 to 10 meters, and 10 to about 20 meters were isolated by both processes. Where clear water and uniformly reflective bottom was found, clear of marine growths, the photo-optical and electronic image density slicing processes proved effective in delineating areas where the depth was in the order of 5 meters, plus or minus 1 meter.

N73-26333*# Corps of Engineers, San Francisco, Calif.
CALIFORNIA COAST NEARSHORE PROCESSES STUDY Progress Report, 1 May - 30 Jun. 1973
Douglas M. Pirie and David D. Stellar, Principal Investigators (Rockwell Intern. Corp., Downey, Calif.) Jul. 1973 9 p ERTS (NASA Order S-70257-AG)
(E73-10727; NASA-CR-133071; ERTS-1-1-4; PR-4) Avail: NTIS HC \$3.00 CSCL 08C

The author has identified the following significant results. During the period 1 May to 30 June 1973 material was processed and interpreted for use in analyzing the three ocean seasons along the California coast. ERTS imagery from the first season of the year, called the Davidson Current period, was mosaiced and analyzed. The second season of the year, the Upwelling period, was mosaiced and interpretation was initiated. Imagery for the third ocean season, the Oceanic period, is being collected for future study.

N73-26341*# Long Island Univ., Greenvale, N.Y. Science Engineering Research Group.
AN INTERDISCIPLINARY STUDY OF THE ESTUARINE AND COASTAL OCEANOGRAPHY OF BLOCK ISLAND SOUND AND ADJACENT NEW YORK COASTAL WATERS Progress Report, 15 Dec. 1972 - 15 Feb. 1973
Edward Yost, Principal Investigator 15 Feb. 1973 2 p ERTS (Contract NAS5-21792)
(E73-10735; NASA-CR-133079; ERTS-070) Avail: NTIS HC \$3.00 CSCL 08J

N73-26342*# Long Island Univ., Greenvale, N.Y. Science Engineering Research Group.
AN INTERDISCIPLINARY STUDY OF THE ESTUARINE AND COASTAL OCEANOGRAPHY OF BLOCK ISLAND SOUND AND ADJACENT NEW YORK COASTAL WATERS Progress Report, 15 Feb. - 15 Apr. 1973
Edward Yost, Principal Investigator 15 Apr. 1973 2 p ERTS (Contract NAS5-21792)
(E73-10736; NASA-CR-133080; ERTS-070) Avail: NTIS HC \$3.00 CSCL 08C

N73-26354*# National Marine Fisheries Service, Bay Saint Louis, Miss.
INVESTIGATION USING DATA FROM ERTS TO DEVELOP AND IMPLEMENT UTILIZATION OF LIVING MARINE RESOURCES Progress Report, 10 Mar. - 10 May 1973
William H. Stevenson, Principal Investigator 11 Jun. 1973 4 p ERTS (NASA Order S-70246-AG)
(E73-10751; NASA-CR-133119; PR-4) Avail: NTIS HC \$3.00 CSCL 08A

N73-27243*# Grumman Ecosystems Corp., Bethpage, N.Y.
VIRGIN ISLANDS ERTS-1 EXPERIMENT Progress Report, Feb. - Mar. 1973
W. C. Coulbourn, Principal Investigator 23 Apr. 1973 3 p ERTS (Contract NAS5-21811)
(E73-10767; NASA-CR-133164; GEC73L-295) Avail: NTIS HC \$3.00 CSCL 08F

N73-27254*# Old Dominion Univ. Research Foundation, Norfolk, Va.

THE USE OF ERTS-1 TO MORE FULLY UTILIZE AND APPLY MARINE STATION DATA TO THE STUDY OF PRODUCTIVITY ALONG THE EASTERN SHELF EXPANDED WATERS OF THE UNITED STATES Bimonthly Report, 1 Apr. - 31 May 1973

Harold G. Marshall 31 May 1973 2 p ERTS

(Contract NAS5-21816)

(E73-10778; NASA-CR-133145) Avail: NTIS HC \$3.00 CSCL 08A

N73-27256*# National Oceanic and Atmospheric Administration, Miami, Fla.

REMOTE SENSING OF OCEAN CURRENTS Bimonthly Report, 4 May - 4 Jul. 1973

George A. Maul, Principal Investigator 4 Jul. 1973 24 p refs ERTS

(NASA Order S-70246-AG)

(E73-10780; NASA-CR-133147) Avail: NTIS HC \$3.25 CSCL 08C

The author has identified the following significant results. Sea ice is detectable in all of the MSS bands and can be distinguished from clouds through a number of interpretive keys. Overall, MSS-4 and 5 appear to be better for mapping the ice edge, whereas MSS-7 provides greater detail in the ice features.

N73-27261*# National Marine Fisheries Service, Bay Saint Louis, Miss.

A SUMMARY OF SELECTED EARLY RESULTS FROM THE ERTS-1 MENHADEN EXPERIMENT

William H. Stevenson, Principal Investigator, Andrew J. Kemmerer, Joseph A. Benigno, Gladys B. Reese, and Frederick C. Minkler 29 Jun. 1973 37 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(NASA Order S-70246-AG)

(E73-10785; NASA-CR-133152) Avail: NTIS HC \$4.00 CSCL 08A

The author has identified the following significant results. Imagery from ERTS-1 satellite was used in conjunction with aerial photographically-sensed menhaden distribution information, sea truth oceanographic measurements, and commercial fishing information from a 8685 square kilometer study area in the north-central portion of the Gulf of Mexico to demonstrate relationships between selected oceanographic parameters and menhaden distribution. ERTS-1 imagery and menhaden distribution, and ERTS-1 imagery and oceanographic parameters. ERTS-1, MSS band 5 imagery density levels correlated with photographically detected menhaden distribution patterns and could be explained based on sea truth Secchi disc transparency and water depth measurements. These two parameters, together with surface salinity, Forel-Ule color, and chlorophyll-a also were found to correlate significantly with menhaden distribution. Eight empirical models were developed which provided menhaden distribution predictions for the study area on combinations of Secchi disc transparency, water depth, surface salinity, and Forel-Ule color measurements.

N73-27264*# Geological Survey, Menlo Park, Calif.

PRINCIPAL SOURCES AND DISPERSAL PATTERNS OF SUSPENDED PARTICULATE MATTER IN NEARSHORE SURFACE WATERS OF THE NORTHEAST PACIFIC OCEAN AND THE HAWAIIAN ISLANDS Progress Report, 1 Apr. - 31 May 1973

Paul R. Carlson, Principal Investigator 12 Jun. 1973 9 p ref ERTS

(NASA Order S-70243-AG-7)

(E73-10788; NASA-CR-133155) Avail: NTIS HC \$3.00 CSCL 08J

The author has identified the following significant results.

ERTS-1 green and red band imagery supplemented by U-2 photographs provides synoptic views of turbid, nearshore, near-surface bodies of water which adds to the body of knowledge about the coastal ocean necessary for a thorough understanding of the dynamic environment. Turbidity and suspended sediment measurements made in the Gulf of the Farallones correlate well with water tonal patterns visible on satellite imagery. Three successively seaward zones of turbid water could be delineated. Secchi disc visibility tests were the most definitive, ranging from $< \text{ or } = 2$ meters in the main plume, to almost 3 meters in the second zone of turbid water, to 4 meters in the furthest seaward zone of turbid water measured. These variations in water clarity were reinforced by suspended sediment concentrations which ranged from 26-28 mg/l, to 20-24 mg/l, to 11-15 mg/l, respectively, in each of the three masses of water. Transmissometer readings were basically in agreement with the suspended sediment and Secchi disc values measured. Satellite imagery and U-2 photographs of the California coastal zone taken early in April 1973 show numerous plumes of suspended sediment being deflected southward. This indicates a southward flow of the nearshore, near-surface waters, a reversal from that noted in January 1973.

N73-27269*# National Environmental Satellite Service, Washington, D.C.

EVALUATION OF ERTS DATA FOR CERTAIN OCEANOGRAPHIC USES Progress Report, May - Jun. 1973

Alan E. Strong, Principal Investigator [1973] 2 p ERTS

(NASA Order S-70246-AG)

(E73-10793; NASA-CR-133160) Avail: NTIS HC \$3.00 CSCL 08C

The author has identified the following significant results. A significant result was reported 13 July on anomalous dark patches observed in certain ERTS-1 images. This sunglint related feature is possible whenever the solar elevation is greater than 55 deg and the surface waters are calm. It is observed in all MSS bands. Although the bright specular point is nearly 300 nm from nadir no bright specular returns are possible with a 0930 local time descending path-only diffuse glitter, that may reach reflectance levels of 1-2% under wind speeds of 5-10 m/sec and solar elevations greater than 60 deg.

N73-27270*# Army Engineer Waterways Experiment Station, Vicksburg, Miss.

SEDIMENT PATTERN CORRELATION WITH INFLOW AND TIDAL ACTION Progress Report

Warren E. Grabau, Principal Investigator 17 Jul. 1973 1 p ERTS

(NASA Order S-70259-AG)

(E73-10794; NASA-CR-133161) Avail: NTIS HC \$3.00 CSCL 08J

N73-27294*# Long Island Univ., Greenvale, N.Y. Science Engineering Research Group.

AN INTERDISCIPLINARY STUDY OF THE ESTUARINE AND COASTAL OCEANOGRAPHY OF BLOCK ISLAND SOUND AND ADJACENT NEW YORK COASTAL WATERS Interim Report, Jan. - Jun. 1973

Edward F. Yost, Principal Investigator Jun. 1973 24 p Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21792)

(E73-10819; NASA-CR-133313; TR-20-2) Avail: NTIS HC \$3.25 CSCL 08C

The author has identified the following significant results. ERTS-1 imagery of New York coastal waters has been photographically enhanced to emphasize apparent water color differences. Water samples have been collected simultaneously with the acquisition of satellite data. Water turbidity, particularly that arising from sewage dump areas, and sediment discharge from coastal inlets correlate well with the ERTS-1 color signatures.

N73-27295*# Geological Survey, Tacoma, Wash.

A LAKE AND SEA ICE EXPERIMENT WITH SKYLAB MICROWAVE RADIOMETRY Progress Report

W. J. Campbell, Principal Investigator 27 Jul. 1973 1 p Sponsored by NASA EREP

(E73-10820; NASA-CR-133314) Avail: NTIS HC \$3.00 CSCL 08L

N73-27297*# Ecole Practique des Hautes Etudes, Paris (France). Lab. de Geomorphologie.

TELEDETECTION OF LITTORAL FRALIT PROGRAM ERTS-1 [LA TELEDETECTION DU LITTORAL PROGRAMME FRALIT ERTS 1]

Fernand Verger, Principal Investigator and Pierre DeMathieu 1973 24 p refs In FRENCH Sponsored by NASA Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(E73-10822; NASA-CR-133323) Avail: NTIS HC \$3.25 CSCL 08A

N73-27328# TRW Systems Group, Redondo Beach, Calif.

OCEAN COLOR DATA ANALYSIS APPLIED TO MOCS AND SIS DATA

R. C. Ramsey and P. G. White Jul. 1973 81 p refs Original contains color illustrations

(Contract N62206-72-C-0037)

(TRW-21123-6001-RU-00) Avail: NTIS HC \$6.25

Multichannel ocean color sensor data are presented in the form of false color maps. During the data processing to obtain the color maps, a color elevation angle correction has been applied to eliminate the problem of shading. Computer programs used in the data analyses are described, and a novel technique for reducing ocean color data using second derivatives of the spectral curves is reported. G.G.

N73-27333*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

DYNAMICS AND MORPHOLOGY OF BEAUFORT SEA ICE DETERMINED FROM SATELLITES, AIRCRAFT, AND DRIFTING STATIONS

W. J. Campbell (Geological Survey, Takoma, Wash. and Univ. of Puget Sound, Takoma, Wash.), P. Gloersen, W. Nordberg, and T. T. Wilheit Jun. 1973 33 p refs Submitted for publication (NASA-TM-X-66291; X-650-73-194) Avail: NTIS HC \$3.75 CSCL 08L

A series of measurements from drifting stations, aircraft, the ERTS-1, Nimbus 4, and Nimbus 5 satellites have jointly provided a new description of the dynamics and morphology of the ice cover of the Beaufort Sea. The combined analysis of these data show that the eastern Beaufort Sea ice cover is made up of large multiyear floes while the western part is made of small, predominantly first-year floes. The analysis suggests that this distribution might be quasi-steady and that the dynamics and thermodynamics of the region are more complex than hitherto known. The measurements consist of: (1) high resolution ERTS-1 imagery which is used to describe floe size and shape distribution, short term floe dynamics, and lead and polynya dynamics; (2) tracking by Nimbus 4 of IRLS drifting buoys to provide ice drift information which enhances the interpretation of the ERTS-1 imagery; (3) Nimbus 5 microwave (1.55 cm wavelength) imagery which provides synoptic, sequential maps on the distribution of multiyear and first-year ice types; (4) airborne microwave surveys and surface based observations made during 1971 and 1972 in conjunction with the AIDJEX (Arctic Ice Dynamics Joint Experiment) program. Author

N73-27353*# Woods Hole Oceanographic Institution, Mass. APPLICATION OF SPECTROMETRY TO BIOLOGICAL OCEANOGRAPHY Final Report

George L. Clarke and Gifford C. Ewing Feb. 1973 36 p refs

05 OCEANOGRAPHY AND MARINE RESOURCES

(Grant NGR-22-014-016; Contract N62306-71-C-0195)
(NASA-CR-133325; AD-758687; WHOI-73-8) Avail: NTIS HC
\$4.00 CSCL 08/1

The report describes an investigation for measuring ocean color from the air, for correlating it with the physical and biological conditions of the sea, and for interpreting the data obtained. The feasibility of mapping and distinguishing between ocean areas containing low and moderate chlorophyll concentrations from flight altitudes up to 15,000 feet is shown experimentally by means of an airborne spectrophotometer. Author (GRA)

N73-27354# Woods Hole Oceanographic Institution, Mass.
SYNOPTIC VIEW OF THE CARIBBEAN SEA SURFACE TOPOGRAPHY

J. P. Dean and C. B. McCullough Aug. 1972 15 p refs
(Contract N00014-66-C-0241; NR Proj. 083-004)
(AD-759041; WHOI-72-64) Avail: NTIS CSCL 08/10

Theoretical estimates of some factors which affect the topography of the sea surface are given for the Caribbean Sea. Weather and oceanographic effects which act on the ocean surface eventually to be mapped by an orbiting GEOS-C satellite are discussed in terms of their relative magnitudes and general distribution over the area of interest. Author (GRA)

N73-27369# Florida Univ., Gainesville. Coastal and Oceanographic Engineering Lab.
LABORATORY INVESTIGATIONS OF WHITECAPS, SPRAY AND CAPILLARY WAVES

O. H. Shemdin, R. J. Lai, A. Reece, and G. Tober Dec. 1972 114 p refs
(Contract N62306-71-C-0033)
(AD-759407; TR-11) Avail: NTIS CSCL 08/3

Laboratory investigations of whitecaps, spray and capillary waves were conducted in the wind and wave facility at the University of Florida. The percent whitecap area coverage was obtained by taking photographs of the water surface and calibrating for the photographed area distortion. Spray was measured by using a constant temperature hot-wire anemometer system. Calibration was achieved by generating uniform size drops with capillary tubes of different sizes and a crystal vibrator. Capillary waves were investigated by a laser-optical device with a frequency response greater than 100 Hz. The device was designed for the purpose of investigating the dependence of capillary waves on the wind speed. (Author Modified Abstract) GRA

N73-27373# Institute for Defense Analyses, Arlington, Va.
SEA SPECTRA AND RADAR SCATTERING
W. A. Nierenberg and W. H. Munk Aug. 1972 33 p refs
(Contract DAHC15-67-C-0011; Proj. JASON)
(AD-760693; N-817; ISA/HQ-73-150) Avail: NTIS CSCL 08/3

Bistatic radar observation of the power spectrum in ocean wave number space is proposed, and a geometric analysis made of the point mapping from ocean wave spectrum space to delay-Doppler space. In addition, a relationship is found between the Phillips spectrum B constant and the observed HF radar sea return. Author (GRA)

N73-28272* Delaware Univ., Newark. Coll. of Marine Studies.
IDENTIFICATION OF MARSH VEGETATION AND COASTAL LAND USE IN ERTS-1 IMAGERY

V. Klemas, F. Daiber, and D. Bartlett In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 615-627 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(Contract NAS5-21837; Grants NSF GI-33369;

NOAA-GH-109)
(Paper-E8) CSCL 08H

Coastal vegetation species appearing in the ERTS-1 images taken of Delaware Bay on August 16, and October 10, 1972 have been correlated with ground truth vegetation maps and imagery obtained from high altitude RB-57 and U-2 overflights. The vegetation maps of the entire Delaware Coast were prepared during the summer of 1972 and checked out with ground truth data collected on foot, in small boats, and from low-altitude aircraft. Multispectral analysis of high altitude RB-57 and U-2 photographs indicated that five vegetation communities could be clearly discriminated from 60,000 feet altitude including: (1) salt marsh cord grass, (2) salt marsh hay and spike grass, (3) reed grass, (4) high tide bush and sea myrtle, and (5) a group of fresh water species found in impoundments built to attract water fowl. All of these species are shown in fifteen overlay maps, covering all of Delaware's wetlands prepared to match the USGS topographic map size of 1:24,000. Author

N73-28278* Tokyo Univ. (Japan). Inst. of Industrial Science.
A STUDY ON THE EROSION OF NIIGATA BEACH FROM ERTS-A IMAGERY

Takakazu Maruyasu In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 665-672 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-E14A) CSCL 08H

Coastal erosion of Niigata Beach, Japan as a result of construction works is discussed. The application of ERTS-1 imagery for defining and monitoring the extent of the erosion is described. The contribution of ERTS-1 data to studies leading to effective erosion control methods are reported. Author

N73-28280* Kyoto Univ. (Japan).
POLLUTED AND TURBID WATER MASSES IN OSAKA BAY AND ITS VICINITY REVEALED WITH ERTS-A IMAGERIES
Kantaro Watanabe In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 681-687 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-E14C) CSCL 08A

ERTS-1 took very valuable MSS imageries of Osaka Bay and its vicinity on October 24, 1972. In the MSS-4 and MSS-5 imageries a complex grey pattern of water masses can be seen. Though some of grey colored patterns seen in black and white prints of the MSS-4 and MSS-5 imageries are easily identified from their shapes as cloud covers or polluted water masses characterized by their color tone in longer wavelengths in the visible region, any correct distribution pattern of polluted or turbid water masses can be hardly detected separately from thin cloud covers in a quick look analysis. In the present investigation, a simple photographic technique was applied using the fact that reflected sun light from cloud including smog and inclined water surfaces of wave have a certain component in the near infrared region, that MSS-7, whereas the light scattered from fine materials suspended in the sea water has nearly no component sensible in MSS-4 and MSS-5 channels. Author

N73-28341* Maryland Geological Survey, Baltimore.
SEASONAL CHANGES OF LITTORAL TRANSPORT AND BEACH WIDTH AND RESULTING EFFECT ON PROTECTIVE STRUCTURES

Turbit H. Slaughter In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1259-1267 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(Paper-M1) CSCL 08C

The shorelines of Maryland's portion of the Chesapeake Bay exhibit seasonal changes in direction of littoral transport and resulting beach width. Observation and study of this process at selected locations emphasizes the necessity of study for a complete year's seasonal cycle before stating erosion rates of an area to be protected by structures and the cyclical presence or absence of beaches. Seasonal beach conditions at four selected sites are described along with resulting physical changes to protective structures. Through the use of ERTS-1 multi-spectral photography, it will be possible to make widespread predictions elsewhere in the Bay as a direct aid in protective structure design. Author

N73-28342* Maryland Geological Survey, Baltimore.
RECOGNITION OF BEACH AND NEARSHORE DEPOSITIONAL FEATURES OF CHESAPEAKE BAY
Randall T. Kerhin /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1. Vol. 1. Sect. A and B 1973 p 1269-1274 refs ERTS

(Paper-M2) CSCL 08C

Beach and nearshore depositional features are being mapped with the objectives of determining a quick-look analysis of littoral drift and sedimentation patterns in areas of little or no data. Evaluation of beach and nearshore features aid in the selection of small boat harbors, shoreline protective structures, and general coastal zone development. Through ERTS-1 aircraft support imagery, beach depositional features mapped are cusate forelands, welded beach ridges, and recurved spits. The nearshore depositional features exhibit a bar and trough topography with three distinct types of sedimentary structures; longshore, transverse, and reticulated bars. Synoptic coverage of beach and nearshore depositional features by ERTS-1 data help in determining the general sedimentation patterns, growth of the beach features and stability of the bar and trough topography. Author

N73-28343* Delaware Univ., Newark. Coll. of Marine Studies.

APPLICABILITY OF ERTS-1 IMAGERY TO THE STUDY OF SUSPENDED SEDIMENT AND AQUATIC FRONTS
V. Klemas, R. Sma, W. Treasure, and M. Otley /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1. Vol. 1. Sect. A and B 1973 p 1275-1290
Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contracts NAS5-21837; N00014-69-A-0407)

(Paper-M3) CSCL 08J

Imagery from three successful ERTS-1 passes over the Delaware Bay and Atlantic Coastal Region have been evaluated to determine visibility of aquatic features. Data gathered from ground truth teams before and during the overflights, in conjunction with aerial photographs taken at various altitudes, were used to interpret the imagery. The overpasses took place on August 16, October 10, 1972, and January 28, 1973, with cloud cover ranging from about zero to twenty percent. (I.D. Nos. 1024-15073, 1079-15133, and 1187-15140). Visual inspection, density slicing and multispectral analysis of the imagery revealed strong suspended sediment patterns and several distinct types of aquatic interfaces or frontal systems. Author

N73-28344* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

CORRELATION OF ERTS MULTISPECTRAL IMAGERY WITH SUSPENDED MATTER AND CHLOROPHYLL IN LOWER CHESAPEAKE BAY
D. E. Bowker, P. Fleischer (Old Dominion Univ.), T. A. Gosink (Old Dominion Univ.), W. J. Hanna (Old Dominion Univ.), and J. Ludwick (Old Dominion Univ.) /In its Symp. on Significant Results obtained from the ERTS-1. Vol. 1. Sect. A and B 1973 p 1291-1297 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-M4) CSCL 08J

The feasibility of using multispectral satellite imagery to monitor the characteristics of estuarine waters is being investigated. Preliminary comparisons of MSS imagery with suspended matter concentrations, particle counts, chlorophyll, transmittance and bathymetry have been made. Some visual correlation of radiance with particulates and chlorophyll has been established. Effects of bathymetry are present, and their relation to transmittance and radiance is being investigated. Greatest detail in suspended matter is revealed by MSS band 5. Near-surface suspended sediment load and chlorophyll can be observed in bands 6 and 7. Images received to date have partially defined extent and location of high suspensate concentrations. Net quantity of suspended matter in the lower Bay has been decreasing since the inception of the study, and represents the diminution of turbid flood waters carried into the Bay in late September, 1972. The results so far point to the utility of MSS imagery in monitoring estuarine water character for the assessment of sitation, productivity, and water types. Author

N73-28345* Geological Survey, Hartford, Conn.
PLUME DEVELOPMENT IN LONG ISLAND SOUND OBSERVED BY REMOTE SENSING (ERTS-1)

Frederick H. Ruggles, Jr. /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1. Vol. 1. Sect. A and B 1973 p 1299-1303 ref ERTS

(Paper-M5) CSCL 08J

As the Connecticut River flows into Long Island Sound, large plumes are developed during the mixing of ocean and estuarine waters. Plumes were delineated for July 28, October 8, October 27, and December 2, 1972, by analyzing ERTS-1 imagery with the SRI electronic satellite image analysis console (ESIAC). Insertion of MSS band 5 into the ESIAC produced the best result in this analysis. The four plumes that have been delineated provide the first input to a time-lapse analysis of circulation patterns at the eastern end of Long Island Sound. Author

N73-28346* Geological Survey, Menlo Park, Calif. Office of Marine Geology.

NEW INSIGHTS INTO THE INFLUENCE OF ICE ON THE COASTAL MARINE ENVIRONMENT OF THE BEAUFORT SEA, ALASKA

Peter W. Barnes and Erk Reimnitz /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1. Vol. 1. Sect. A and B 1973 p 1307-1314 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-M7) CSCL 08L

Areal patterns from field data and ERTS-1 imagery have shown a close relationship between geologic processes and the influence of sea ice along Alaska's northern coast, perhaps the nation's least known continental margin. Ice acts as: (1) a bottom-gouging agent; (2) an influence on water circulation; (3) a carrier of sediments; and (4) an influence on water types. Author

N73-28347* Alaska Univ., Fairbanks. Inst. of Marine Science.
ERTS-1 OBSERVATIONS OF SEA SURFACE CIRCULATION AND SEDIMENT TRANSPORT, COOK INLET, ALASKA

F. F. Wright, G. D. Sharma, and D. C. Burbank /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1. Vol. 1. Sect. A and B 1973 p 1315-1322 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-M8) CSCL 08J

Cook Inlet is a large tide-dominated estuary in southern Alaska. Highly turbid streams enter the upper inlet, providing an excellent tracer for circulation in the lower inlet. MSS 4 and 5 images both can be used in this area to plot sediment and pollutant trajectories, areas of (probable) commercial fish concentration, and the entire circulation regime. Author

N73-28348* Army Cold Regions Research and Engineering Lab., Hanover, N.H.

SEDIMENT DISTRIBUTION AND COASTAL PROCESSES IN COOK INLET, ALASKA

Duwayne M. Anderson, Lawrence W. Gatto, Harlan L. McKim, and Anthony Petrone / *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1323-1339 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-M9) CSCL 08J

Regional hydrologic and oceanographic relationships in Cook Inlet, Alaska have been recognized from sequential ERTS-1 MSS imagery. Current patterns are visible in the inlet because of differential concentrations of suspended sediment. The circulation patterns within Cook Inlet are controlled primarily by the interaction between the semi-diurnal tides and the counter clockwise Alaska current. In general, heavily sediment laden water is seen to be confined to portions of the inlet north of the Forelands and west of Kalgin Island. Tongues of clear oceanic water are observed to enter the inlet through Kennedy Channel along the east shoreline in the vicinity of Cape Elizabeth. A recurring counterclockwise circulation pattern observed around Kalgin Island seems to result from the interplay of the northerly moving water along the east shore and the southerly moving, sediment laden, water along the west side of the inlet. Prominent, fresh water plumes, heavily laden with sediment are visible at the mouths of all major rivers. Reflect plumes from as many as three tidal stages have been recognized. Author

N73-28349* Geological Survey, Corpus Christi, Tex.
DISTRIBUTION AND MOVEMENT OF SUSPENDED SEDIMENT IN THE GULF OF MEXICO OFF THE TEXAS COAST

Ralph E. Hunter / *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1341-348 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-M10) CSCL 08J

ERTS-1 imagery has proven very useful in studies of the distribution of suspended sediment in the Gulf of Mexico off the Texas coast. Moreover, by using suspended matter concentrations as tags, on water masses, much information on water movement can be obtained. The utility of suspended sediment as a tracer is dependent on the sediment remaining in suspension long enough to travel an appreciable distance or to be visible on successive images. Although the evidence is not conclusive, it seems likely that much of the suspended sediment in Gulf of Mexico nearshore waters during normal seastate conditions has remained in suspension since the time of its entry into the Gulf of Mexico through rivers and tidal inlets. Author

N73-28350* Arizona Univ., Tucson.
OCEANOGRAPHIC MAPPING OF STRUCTURE AND DYNAMICS OF THE NORTHERN GULF OF CALIFORNIA BY THE USE OF SPECTRAL MODELING AND ERTS-1

L. K. Lepley, Gustavo Calderon, and J. R. Hendrickson / *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1349-1358 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-M11) CSCL 08J

Distribution and flow of water masses at four depth intervals were determined by analyzing ERTS imagery through the use of optical models of classes of vertical oceanographic profiles. Data used for these models was obtained from shipboard measurements including surface spectral radiance, and optical and more conventional oceanographic depth profiles. The spectral models obtained were applied to radiance-contoured ERTS imagery in band 4, 5, 6, and 7. Features mapped by direct photointerpretation of ERTS imagery include submerged shoals, current streamlines,

and location of possible upwellings, downwellings and submarine springs. Author

N73-28351* National Oceanic and Atmospheric Administration, Miami, Fla. Atlantic Oceanographic and Meteorological Lab.
OCEANOGRAPHIC FEATURES IN THE LEE OF THE WINDWARD AND LEEWARD ISLANDS: ERTS AND SHIP DATA

Kirby J. Hanson, Frank Hebard, and Richard Cram (Miami Univ., Coral Gables, Fla.) / *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1357-1383 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-M12) CSCL 08J

Analysis of the ERTS data in portions of the eastern Caribbean are presented for October 1972 showing features which are, as yet, not explained. Ground truth data obtained in that area during November 1972 are presented. These include vertical temperature structure in the mixed layer and thermocline, and surface measurements of salinity, temperature, and chlorophyll. Author

N73-28352* National Oceanic and Atmospheric Administration, Miami, Fla. Atlantic Oceanographic and Meteorological Lab.
REMOTE SENSING OF OCEAN CURRENTS USING ERTS IMAGERY

George A. Maul / *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1365-1375 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-M13) CSCL 08C

Major ocean currents such as the Loop Current in the eastern Gulf of Mexico have surface manifestations which can be exploited for remote sensing. Surface chlorophyll-a concentrations, which contribute to the shift in color from blue to green in the open sea, were found to have high spatial variability; significantly lower concentrations were observed in the current. The cyclonic edge of the current is an accumulation zone which causes a peak in chlorophyll concentration. The dynamics also cause surface concentrations of algae, which have a high reflectance in the near infrared. Combining these observations gives rise to an edge effect which can show up as a bright lineation on multispectral imagery delimiting the current's boundary under certain environmental conditions. When high seas introduce bubbles, white caps, and foam, the reflectance is dominated by scattering rather than absorption. This has been detected in ERTS imagery and used for current location. Author

N73-28353* Environmental Research and Technology, Inc., Lexington, Mass.
USE OF ERTS DATA FOR MAPPING ARCTIC SEA ICE

James C. Barnes and Clinton J. Bowley / *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1 Vol. 1, Sect. A and B 1973 p 1377-1384 refs ERTS

(Paper-M14) CSCL 08L

This investigation is to evaluate the application of ERTS data for detecting and mapping Arctic sea ice. The specific objectives are to determine the spectral bands most suitable for detecting ice, to measure the scale and types of ice features that can be detected, and to develop interpretive techniques for differentiating ice from clouds and for mapping ice concentrations. The ERTS data are being analyzed primarily for three Arctic areas, the eastern Beaufort Sea, Baffin Bay, and the Greenland Sea. Author

N73-28354* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
BIOMASS IN THE UPWELLING AREAS ALONG THE

NORTHWEST COAST OF AFRICA AS VIEWED WITH ERTS-1

Karl-Heinz Szekielda (Delaware Univ.) and Robert J. Curran *In its Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1385-1401* Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-M15) CSCL 08A

Light penetration in water is affected by plankton, algae, and dissolved and suspended matter. As a consequence, the composition of backscattered light from below the air-sea interface is determined by the nature of the constituents in the water column. In contrast to the absorption spectrum of chemically pure chlorophyll in solution, algae suspensions absorb and scatter light more uniformly throughout the visible part of the electromagnetic spectrum. Because of their spectral absorption and scattering properties plankton concentration can be estimated by measuring the spectral backscattered radiance over water. Experiments using this approach were performed in upwelling regions along the northwest coast of Africa. Author

N73-28355* Earth Satellite Corp., Washington, D.C. APPLICATION OF ERTS-1 IMAGERY TO THE HARVEST MODEL OF THE US MENHADEN FISHERY

Paul M. Maughan, Allan D. Marmelstein, and O. Ray Temple *In NASA, Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1405-1411* Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-M17) CSCL 08A

Preliminary results of an experiment to demonstrate the utility of ERTS-1 imagery for providing significant information to the harvest model of the menhaden industry are reported. Fisheries and related environmental data were obtained discontinuously throughout the 1973 menhaden (a surface schooling, coastal species) fishing season in Mississippi Sound. The unexpected complexity of the physical environment in Mississippi Sound precluded simplistic analysis of fish/environment relationships. Preliminary indications are that an association does exist between fish availability and differences in water transparency (turbidity) within the Sound. A clearer relationship is developing between major turbid features, imaged by ERTS-1 and location of successful fishing attempts. On all occasions where relatively cloudfree ERTS-1 overflight days coincided with fishery activity, overlays of catch location of ERTS-1 images show an association of school position with interfaces between imaged turbid features. Analysis is currently underway to determine persistence of such associations in an attempt to define minimum satellite return time necessary to maintain continuity of associations. Author

N73-28356* Geological Survey, Washington, D.C. COASTAL AND SUBMARINE FEATURES ON MSS IMAGERY OF SOUTHEASTERN MASSACHUSETTS: COMPARISON WITH CONVENTIONAL MAPS

Richard S. Williams, Jr. *In NASA, Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1413-1422* refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-M18) CSCL 08B

Three ERTS-1, MSS images of southeastern Massachusetts, including Cape Cod Bay, Cape Cod, and Nantucket Sound, show a variety of dynamic geologic and hydrologic phenomena. Coastal features imaged include the coastline at different time in the tidal cycle, harbors, lakes and ponds, marshes (wetlands), and beach and dune areas; submarine features include tidal flats, shoals, dredged and natural channels, and bars. Comparison with conventional maps at 1:1,000,000 and 1:250,000 scales show many inaccuracies between the ERTS imagery and the two map scales. The ERTS-1 imagery can be used to increase the accuracy of these maps, portray additional environmental information, and

provide the capability for frequent updating of maps at such scales. ERTS-1 imagery provides a very cost effective method for provision of certain types of environmental data for Cape Cod and environs. Author

N73-28357* International Imaging Systems, Mountain View, Calif.

WATER DEPTH ESTIMATION WITH ERTS-1 IMAGERY

D. S. Ross *In NASA, Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1423-1432* refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-M19) CSCL 08J

Contrast-enhanced 9.5 inch ERTS-1 images were produced for an investigation on ocean water color. Such images lend themselves to water depth estimation by photographic and electronic density contouring. MSS-4 and -5 images of the Great Bahama Bank were density sliced by both methods. Correlation was found between the MSS-4 image and a hydrographic chart at 1:487,000 scale, in a number of areas corresponding to water depth of less than 2 meters, 5 to 10 meters and 10 to about 20 meters. The MSS-5 image was restricted to depths of about 2 meters. Where reflective bottom and clear water are found, ERTS-1 MSS-4 images can be used with density contouring by electronic or photographic methods for estimating depths to 5 meters within about one meter. Author

N73-28358* Environmental Research Inst. of Michigan, Ann Arbor.

CALCULATIONS OF WATER DEPTH FROM ERTS-MSS DATA

Fabian C. Polcyn and David R. Lyzenga *In NASA, Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1433-1441* refs Original Contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-M20) CSCL 08J

ERTS-1 MSS data taken on October 10, 1972 of the Little Bahama Bank are being used to demonstrate the use of ERTS-1 data for mapping of shallow water features for the purpose of upgrading world navigation charts. Marked reflectance differences occur for the shallow water areas in Bands 4, 5, and 6. Digital processing of two adjacent data tapes within the ERTS frame covering an area of about 40 by 40 miles has been completed. Correlation of depth measurements to 5 meters has been successful. A mathematical model for depth measurements using ratio of voltages in Band 4 and 5 has been successfully developed and is being tested for accuracy. Additional studies for areas near Puerto Rico and in Northern Lake Michigan will be undertaken. Satellite data will also provide geographical evidence for verifying existence or nonexistence of doubtful shoal waters now appearing on world charts and considered to be hazardous to shipping. Author

N73-28383* Lockheed Electronics Co., Houston, Tex. Aerospace Systems Div.

UNSUPERVISED CLASSIFICATION AND AREAL MEASUREMENT OF LAND AND WATER COASTAL FEATURES ON THE TEXAS COAST

L. M. Flores, C. A. Reeves, S. B. Hixon, and J. F. Paris *In NASA, Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1675-1681* refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

CSCL 08J

Multispectral scanner (MSS) digital data from ERTS-1 was used to delineate coastal land, vegetative, and water features in two portions of the Texas Coastal Zone. Data (Scene ID's 1037-16244 and 1037-16251) acquired on August 29, 1972,

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were analyzed on NASA Johnson Space Center systems through the use of two clustering algorithms. Seventeen to 30 spectrally homogeneous classes were so defined. Many classes were identified as being pure features such as water masses, salt marsh, beaches, pine, hardwoods, and exposed soil or construction materials. Most classes were identified to be mixtures of the pure class types. Using an objective technique for measuring the percentage of wetland along salt marsh boundaries, an analysis was made of the accuracy of areal measurement of salt marshes. Accuracies ranged from 89 to 99 percent. Aircraft photography was used as the basis for determining the true areal size of salt marshes in the study sites. Author

N73-28384* Department of the Environment, Victoria (British Columbia). Marine Sciences Directorate:
USE OF ERTS-1 PICTURES IN COASTAL OCEANOGRAPHY IN BRITISH COLUMBIA

J. F. R. Gower /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1683 ERTS

CSCS 08J

The ERTS-1 color composite picture of the Vancouver-Victoria region illustrates the value of ERTS data for coastal oceanography. The water of the Fraser River plume which is so clearly visible in the center of the scene has been of interest to oceanographers on the west coast of Canada for a long time as an easily visible tracer of surface water circulation in the strait of Georgia. Maps of the plume at different states of the tide and with different river flow and weather were compiled from oblique aerial photographs in 1950 and used in the siting of sewage and other outfalls in the Vancouver area. More recently high level aerial photomosaics have been used to map the plume area, but the plume can spread over distances of 30 to 40 miles and many photographs, with the uneven illumination inherent in wide angle coverage, are needed for the mosaic. The ERTS satellite gives the first complete view of the plume area. Electronic enhancement of the images shows that the satellite's narrow angle coverage allows very weak surface turbidity features to be made visible to give information on surface currents over a wide area. Author

N73-28385* Bureau of Commercial Fisheries, Pascagoula, Miss. Southeast Fisheries Center.

RELATIONSHIPS BETWEEN REMOTELY SENSED FISHERIES DISTRIBUTION INFORMATION AND SELECTED OCEANOGRAPHIC PARAMETERS IN THE MISSISSIPPI SOUND

Andrew J. Kemmerer and Joseph A. Benigno /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1685-1695 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

CSCS 08A

A feasibility study to demonstrate the potential of satellites for providing fisheries significant information was conducted in the Mississippi Sound and adjacent offshore waters. Attempts were made to relate satellite acquired imagery to selected oceanographic parameters and then to relate these parameters to aircraft remotely sensed distribution patterns of resident surface schooling fishes. Initial results suggest that this approach is valid and that the satellite acquired imagery may have important fisheries resource assessment implications. Author

N73-28386* Army Coastal Engineering Research Center, Washington, D.C.

APPLICATION OF ERTS-1 IMAGERY IN COASTAL STUDIES

Orville T. Magoon, Dennis W. Berg, and Robert J. Hallermeier /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1697-1698 ERTS

CSCS 08C

The basic ERTS output is four black-and-white photographs presenting the same scene recorded in each multispectral scanner band. Mosaics covering large regions at a 1:250,000 scale can be compiled from these photographs. Office study of the image of each band separately, in combination with other bands, and in conjunction with other available data (navigation charts, tide tables, etc.) permits extraction of data useful in coastal engineering planning and coastal processes studies. Specific examples in which significant information on regional shoreline configuration or nearshore water movements has been obtained from unenhanced ERTS imagery are: (1) tidal inlet configuration; (2) navigation information; and (3) nearshore water movements. Author

N73-28388* Geological Survey, Tampa, Fla.
DETECTION OF TURBIDITY DYNAMICS IN TAMPA BAY, FLORIDA USING MULTISPECTRAL IMAGERY FROM ERTS-1

A. E. Coker, Aaron Higer, and Carl R. Goodwin /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1715-1726 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

CSCS 08C

In 1970, Congress authorized the deepening of the Tampa Bay channel (Rivers and Harbors Act of 1970) from 34 to 44 feet. In order to determine the effects of this deepening on circulation, water quality, and biota, during and after the construction, the U.S. Geological Survey, in cooperation with the Tampa Port Authority, has collected data and developed a digital simulation model of the bay. In addition to data collected using conventional tools, use is being made of data collected from ERTS-1. Return beam vidicon (RBV) multispectral data were collected, while a shell dredging barge was operating in the bay, and used for turbidity recognition and unique spectral signatures representative of type and amount of material in suspension. A three-dimensional concept of the dynamics of the plume was achieved by superimposing the parts of the plume recognized in each RBV band. This provides a background for automatic computer processing of ERTS data and three-dimensional modeling of turbidity plumes. (Author)

N73-28402* Woods Hole Oceanographic Institution, Mass.
A PRELIMINARY ASSESSMENT OF ERTS IMAGERY FOR MARINE RESOURCES

Gifford C. Ewing /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 2 May 1973 p 146-150 Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

CSCS 08A

The application of ERTS-1 imagery to identifying marine resources is discussed. Specific reference is made to the use of ERTS-1 for observing the onset of the spring growing season in the ocean while it occurs. ERTS-1 data is used for the following purposes: (1) location of large areas of seasonally variable biological activity, (2) measurement of water depth in shallow seas, (3) monitoring of sewer discharges, (4) assessment of erosion damage to beaches and shoreline installations, and (5) navigation through ice-filled waterways. Author

N73-28411* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

MARINE RESOURCES AND OCEAN SURVEYS

James R. Greaves /In its Symp. on Significant Results obtained from the ERTS-1, Vol. 3 May 1973 p 71-82 refs ERTS

CSCS 08A

A synopsis of significant results achieved within the marine resources and ocean surveys discipline of the overall ERTS program is provided. Summaries are provided of the following subdisciplines: (1) coastal processes; (2) bathymetry; (3) sea ice; (4) oceanic circulation and dynamics; and (5) living marine resources. A.L.

N73-28425* Naval Research Lab., Washington, D.C.
DETERMINATION OF SEA SURFACE CONDITIONS USING SKYLAB L-BAND AND RADSCAT PASSIVE MICROWAVE RADIOMETERS Monthly Progress Report
 James P. Hollinger, Principal Investigator 23 Jul. 1973 2 p
 EREP
 (NASA Order T-4126-B)
 (E73-10847; NASA-CR-133426) Avail: NTIS HC \$3.00 CSCL 08J

N73-28429* Old Dominion Univ. Research Foundation, Norfolk, Va.
INVESTIGATION TO RELATE THE CHLOROPHYLL AND SUSPENDED SEDIMENT CONTENT IN THE WATERS OF THE LOWER CHESAPEAKE BAY TO ERTS-1 IMAGERY Bimonthly Report, 1 Apr. - 31 May 1973
 Peter Fleischer, John C. Ludwick, T. A. Gosink, David Bowker, Principal Investigators, and W. J. Hanna 13 Aug. 1973 2 p
 ERTS
 (Contract NAS5-21816)
 (E73-10851; NASA-CR-133439) Avail: NTIS HC \$3.00 CSCL 08J

N73-28455 Institute of Coastal Oceanography and Tides, Birkenhead (England).
THE APPLICATION OF MULTISPECTRAL SCANNING SYSTEMS TO OCEANOGRAPHY
 D. A. Huntley In Plessey Radar Res. Center Multispectral Scanning Systems and their Potential Appl. to Earth Resource Surveys Apr. 1973 p 151-192 refs

The optical properties of the sea and remote sensing techniques in oceanography are briefly reviewed. The problems and potential for multispectral scanning for sea surface temperature, coastal topography and water sediment load, marine biology and ecology, sea ice, and oil slicks are discussed. Suggestions are made for further study. ESRO

N73-28463* International Imaging Systems, Mountain View, Calif.
EXPERIMENTS IN OCEANOGRAPHIC AEROSPACE PHOTOGRAPHY. 2: IMAGE ACQUISITION AND ENHANCEMENT TECHNIQUES Final Report
 D. S. Ross 28 Feb. 1973 109 p refs
 (Contract N62306-71-C-0045)
 (AD-761663; IS-TR-28-2-73) Avail: NTIS CSCL 08/10

The general objectives of the contract were to continue experimental work for the improvement of techniques in the photographic acquisition through the atmosphere of oceanographic image information, and its subsequent enhancement for data extraction by various photo-optical or other means. The work accomplished falls in two interrelated categories: Gross effects of the atmosphere on oceanographic imagery, and the enhancement of ocean images by photo-optical and electronic methods. GRA

N73-29216* Environmental Research and Technology, Inc., Lexington, Mass.
USE OF ERTS DATA FOR MAPPING ARCTIC SEA ICE Progress Report, 1 Jan. - 30 Jun. 1973
 James C. Barnes, Principal Investigator and C. James Bowley Jul. 1973 23 p ERTS
 (Contract NAS5-21802)
 (E73-10865; NASA-CR-133454) Avail: NTIS HC \$3.25 CSCL 08L

The author has identified the following significant results. Data from ERTS passes crossing the Bering Sea in early March have been correlated with ice observations collected in the Bering Sea Experiment (BESEX). On two flights of the NASA CV-990

aircraft, the ice conditions in the vicinity of St. Lawrence Island reported by the onboard observer are in close agreement with the ice conditions mapped from the corresponding ERTS imagery. The ice features identified in ERTS imagery and substantiated by the aerial observer include the locations of boundaries between areas consisting of mostly grey ice and of mostly first and multi-year ice, the existence of shearing leads, and the occurrence of open water with the associated development of stratus cloud streaks. The BESEX correlative ice formation verifies the potential of practical applications of ERTS data.

N73-29250* Alaska Univ., Fairbanks. Inst. of Marine Science.
SEA-ICE AND SURFACE WATER CIRCULATION, ALASKAN CONTINENTAL SHELF Semiannual Technical Report, Feb. - Jul. 1973
 F. F. Wright, G. D. Sharma, and J. J. Burns, Principal Investigators 31 Jul. 1973 37 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (Contract NAS5-21833)
 (E73-10901; NASA-CR-133558; SATR-2) Avail: NTIS HC \$4.00 CSCL 08C

The author has identified the following significant results. Over 1500 water samples from surface and from standard hydrographic depths were collected during June and July 1973 from Bering Sea and Gulf of Alaska. The measurement of temperature, salinity, and productivity indicated that various distinct water masses cover the Bering Sea Shelf. The suspended load in surface waters will be correlated with the ERTS-1 imagery as it becomes available to delineate the surface water circulation. The movement of ice floes in the Bering Strait and Bering Sea indicated that movement of ice varies considerably and may depend on wind stress as well as ocean currents.

N73-29251* Alaska Univ., Fairbanks. Inst. of Marine Science.
THE CIRCULATION OF PRINCE WILLIAM SOUND Semiannual Technical Report, Feb. - Jul. 1973
 Robin D. Muench, Principal Investigator 31 Jul. 1973 8 p ERTS
 (Contract NAS5-21833)
 (E73-10902; NASA-CR-133559; SATR-2) Avail: NTIS HC \$3.00 CSCL 08C

N73-29256* Old Dominion Univ. Research Foundation, Norfolk, Va.
USE OF ERTS-1 TO UTILIZE AND APPLY MARINE STATION DATA TO STUDY PRODUCTIVITY ALONG EASTERN SHELF EXPANDED WATERS OF THE UNITED STATES Semiannual Report, 1 Feb. - 31 Jul. 1973
 Harold G. Marshall, Principal Investigator 24 Aug. 1973 11 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57298 ERTS (Contract NAS5-21816)
 (E73-10907; NASA-CR-133564) Avail: NTIS HC \$3.00 CSCL 08A

The author has identified the following significant results. Water samples taken in offshore waters between Cap Cod, Massachusetts, and Charleston, South Carolina have been used with other sea truth information as a basis to correlate productivity values with ERTS-1 sensory data. Positive correlations were established on January 26, 1973 regarding chlorophyll concentrations and optical density values.

N73-29260* Naval Research Lab., Washington, D.C.
DETERMINATION OF SEA SURFACE CONDITIONS USING SKYLAB L-BAND AND RADSCAT PASSIVE MICROWAVE RADIOMETERS Progress Report
 James P. Hollinger, Principal Investigator 28 Aug. 1973 2 p EREP

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(NASA Order T-4126-B)
(E73-10911; NASA-CR-133568) Avail: NTIS HC \$3.00 CSCL 08J

N73-29271*# National Oceanic and Atmospheric Administration, Miami, Fla. Environmental Research Labs.

REMOTE DETECTION OF OCEANIC EDDIES IN THE LESSER ANTILLES USING ERTS-1 DATA Progress Report

Kirby J. Hanson, Principal Investigator 20 Aug. 1973 7 p
Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(NASA Order S-70246-AG-1)

(E73-10922; NASA-CR-133579) Avail: NTIS HC \$3.00 CSCL 08C

N73-29275*# Arizona Univ., Tucson. Dept. of Biological Sciences.

THE OCCURRENCE OF TRICHOCORIXA RETICULATA IN THE GULF OF CALIFORNIA (HEMIPTERA: CORIXIDAE)

J. R. Hendrickson, Principal Investigator and J. T. Polhemus (Martin Marietta Corp., Denver Colo.) [1973] 2 p refs ERTS
(Contract NAS5-21777; Grant NSF GB-34675)

(E73-10926; NASA-CR-133583) Avail: NTIS HC \$3.00 CSCL 08A

N73-29346 Israel Program for Scientific Translations, Ltd., Jerusalem.

RADAR STUDIES OF THE ICE SHEET IN ANTARCTICA

B. A. Federov *In its* The Tenth Soviet Antarctic Expedition, 1965-1966 (TT-70-50072) 1971 p 197-222 refs Transl. into ENGLISH from Tr. Sov. Antarkt. Eksped. (USSR), v. 49, 1969 474 p

Radar studies of the ice sheet in Antarctic Regions were conducted during the Tenth Soviet Antarctic Expedition. The measurement of glacier thickness by radar depends upon small absorption losses in the ice and an appreciable difference between the electrical properties of ice and underlying rocks to produce adequate reflection of the electromagnetic waves from the glacier bed. A numerical analysis of the radar imagery process is provided. Data are presented in the form of graphs to show the parameters which affect the accuracy of the radar returns. Author

N73-29399# Virginia Inst. of Marine Science, Gloucester Point.

SEQUENTIAL PHOTOGRAPHY FOR COASTAL OCEANOGRAPHY Final Contract Report

Maynard Nichols, Galen Thompson, Mahlon Kelly, and Louis Castiglione Nov. 1972 182 p refs Prepared in cooperation with Virginia Univ., Charlottesville

(Contract N00012-71-C-0371; N00014-72-C-0268)

(AD-760713) Avail: NTIS CSCL 08/10

Dynamic features of coastal waters can be detected and monitored in sequential photography by: (1) pattern interpretation, (2) simple comparative analyses, (3) matching of positive-negative pairs, and (4) comparative densitometry. Procedures for densitometric analyses of temporal changes are given. Application of the procedures is demonstrated by analyses of tones representing suspended sediment and plankton in the James estuary and lower Chesapeake Bay. Field and photographic studies revealed four types of water color boundaries that form either in local convergence zones of secondary currents or where water masses of different origin meet. Color changes were partly due to sediment concentration differences and were sometimes manifest by microplankton community changes, but the relationships are complex and variable. Author (GRA)

N73-29441*# National Aeronautics and Space Administration, Washington, D.C.

A THERMOMETER OVER THE SEA

N. Linko Aug. 1973 4 p Transl. into ENGLISH from Leningr. Pravda (Leningrad), 8 May 1973 p 4

(NASA-TT-F-15070) Avail: NTIS HC \$3.00 CSCL 14B

An airborne radiometer for continuously measuring the sea water temperature is described. The instrument detects infrared radiation and converts it to electrical signals which are recorded as temperature with an accuracy within 0.2 degrees. Its use for locating pelagic fish for commercial fishing is briefly discussed. F.O.S.

N73-30274*# National Environmental Satellite Service, Washington, D.C.

EVALUATION OF ERTS DATA FOR CERTAIN OCEANOGRAPHIC USES Bimonthly Report, Jul. - Aug. 1973

Alan E. Strong, Principal Investigator Aug. 1973 2 p ERTS
(NASA Order S-70246-AG)

(E73-10932; NASA-CR-133603; BMR-8) Avail: NTIS HC \$3.00 CSCL 08C

N73-30276*# Delaware Univ., Newark. College of Marine Studies.

APPLICATION OF ECOLOGICAL GEOLOGICAL AND OCEANOGRAPHIC ERTS-1 IMAGERY TO DELAWARE'S COASTAL RESOURCES PLANNING Progress Report, Jul. - Aug. 1973

V. Klemas, Principal Investigator 5 Sep. 1973 7 p refs ERTS

(Contract NAS5-21837)

(E73-10934; NASA-CR-133605) Avail: NTIS HC \$3.00 CSCL 08C

The Author has identified the following significant results. Significant results obtained by analysis of digital ERTS-1 data are: (1) Statistical outputs indicating the reliability of discriminating eight coastal vegetation and land use classes on a given group of training sets included: (a) mean and standard deviation of response in each class chosen; (b) contribution tables indicating importance of each channel in discriminating each thematic class from the background; (c) scatter diagrams showing relationships of thematic spectral signatures in spectral space; and (d) classification table showing reliability (in percent) of identification of each thematic class. (2) Thematic color maps at a scale of 1:1,000,000 showing vegetation and land use categories for Delaware's entire coastal zone. (3) Thematic computer plots at specified smaller (i.e. 1:24,000) scales for comparison with existing map data such as U.S.G.S. topographic maps.

N73-30283*# Arizona Univ., Tucson. Dept. of Biological Sciences.

STUDY OF THE MARINE ENVIRONMENT OF THE NORTHERN GULF OF CALIFORNIA Special Report, period ending 30 Jun. 1973

J. R. Hendrickson, Principal Investigator 30 Jun. 1973 2 p ERTS

(Contract NAS5-21777)

(E73-10941; NASA-CR-133612) Avail: NTIS HC \$3.00 CSCL 08A

The author has identified the following significant results. While occupying standard oceanographic stations in the delta region of the Colorado River, two species of insects were collected which were of special interest. One of these is a single specimen of corixid bug, hitherto familiar to the investigators only as a freshwater insect, but taken swimming actively in high salinity water along with characteristic marine plankton. Further investigation showed that the species taken is well known from saline ponds but this is apparently the first record of its occurrence in a complete marine community. A small note on this collection record was prepared for publication and sent in manuscript form to NASA. The other record is of three specimens of a cicindelid beetle (normally a beach inhabitant) found at a night light for larval fish collection on station in the Colorado delta. The beetles were observed to light on and take off from water surface while actively moving around the night light. There is an interesting question of whether this species (*Cicindela sinuata*)

schrammelli Cazier) may be especially adapted for a predatory life on the surface film, while the other two (larger) species sympatric with it are restricted to hunting on land.

N73-30303*# Earth Satellite Corp., Washington, D.C.
AN INVESTIGATION TO IMPROVE THE MENHADEN FISHERY PREDICTION AND DETECTION MODEL THROUGH THE APPLICATION OF ERTS-A DATA Interim Report, Jan. - Aug. 1973

Paul M. Maughan, Principal Investigator Sep. 1973 17 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21743)

(E73-10961; NASA-CR-133637) Avail: NTIS HC \$3.00 CSCL 08A

The author has identified the following significant results. Linear regression of secchi disc visibility against number of sets yielded significant results in a number of instances. The variability seen in the slope of the regression lines is due to the nonuniformity of sample size. The longer the period sampled, the larger the total number of attempts. Further, there is no reason to expect either the influence of transparency or of other variables to remain constant throughout the season. However, the fact that the data for the entire season, variable as it is, was significant at the 5% level, suggests its potential utility for predictive modeling. Thus, this regression equation will be considered representative and will be utilized for the first numerical model. Secchi disc visibility was also regressed against number of sets for the three day period September 27-September 29, 1972 to determine if surface truth data supported the intense relationship between ERTS-1 identified turbidity and fishing effort previously discussed. A very negative correlation was found. These relationships lend additional credence to the hypothesis that ERTS imagery, when utilized as a source of visibility (turbidity) data, may be useful as a predictive tool.

N73-30310*# Long Island Univ., Greenvale, N.Y. Science Engineering Research Group.

AN INTERDISCIPLINARY STUDY OF THE ESTUARINE AND COASTAL OCEANOGRAPHY OF BLOCK ISLAND SOUND AND ADJACENT NEW YORK COASTAL WATERS Progress Report, 15 Jun. - 15 Aug. 1973

Edward Yost, Principal Investigator 15 Aug. 1973 2 p ERTS (Contract NAS5-21792)

(E73-10968; NASA-CR-133747) Avail: NTIS HC \$3.00 CSCL 08J

N73-30362# New York Univ., N.Y. Dept. of Meteorology and Oceanography.

OCEAN DYNAMICS REMOTE SENSING STUDY Final Report, 21 Jun. 1971 - 30 Jul. 1972

Willard J. Pierson, Jr. Jan. 1973 31 p refs

(Contract N62306-70-A-0075)

(AD-762073; TR-73-3) Avail: NTIS CSCL 08/3

Three of the objectives of the N.Y.U. AAFE program were: (1) to develop improved theories for radar sea return; (2) to define the spectrum of a wind-roughened sea as completely as possible over a full range of wave numbers; and (3) to apply the wave spectrum to the improved theory for sea return. GRA

N73-30380# Inter-American Tropical Tuna Commission, La Jolla, Calif.

APPLICATION OF HIGH RESOLUTION INFRARED AND VISUAL DATA TO INVESTIGATE CHANGES IN THE RELATIONSHIP BETWEEN SEA SURFACE TEMPERATURES AND CLOUD PATTERNS OVER THE EASTERN TROPIC PACIFIC

Merritt R. Stevenson and Forrest R. Miller Jun. 1973 113 p refs

(Contract N00014-72-C-0360)

(AD-763350) Avail: NTIS CSCL 08/10

Results on the application of infrared data from NASA and NOAA satellites for use in the field of fishery oceanography are given. Results of Project Little Window 2 (LW-2) held in the Gulf of California are discussed. Atmospheric attenuation factors are discussed in terms of published research and in terms of the newly acquired field data. A general review of the numerical techniques used for handling infrared data is given. In an application of NIMBUS 4, THIR data in the eastern tropical Pacific, information on the moist marine layer was used to estimate atmospheric attenuation factors, based on curves for model atmospheres. Results of the comparison are discussed in terms of the predicted observed temperature differences. The importance of surface thermal fronts to biota in general and to the tuna fishery in particular, in the eastern tropical Pacific is discussed. Several numerical techniques for producing charts that emphasize thermal gradient features are discussed and results are given for the LW-2 experiment. (Modified author abstract) GRA

N73-31122# Hawaii Univ., Honolulu. Water Resources Research Center.

DIRECT DETERMINATION OF THE ELECTROMAGNETIC REFLECTION PROPERTIES OF SMOOTH BRACKISH WATER TO THE CONTINUOUS SPECTRUM FROM 10 TO THE 8TH POWER TO 4 x 10 TO THE 9TH POWER HERTZ Larry K. Lepley and William M. Adams May 1971 93 p refs (PB-221372/6TR-48; OWRR-B-015-HI(5)) Avail: NTIS HC \$4.85 CSCL 07D

A new geophysical technique for the remote measurement of the electromagnetic properties of natural surfaces was investigated. Theoretical and laboratory work has produced evidence for the validity of the use of ultra-high frequency radio reflection spectrometry for remote sensing of salinity of brackish water. A preliminary study of the electromagnetic properties of aqueous sodium chloride, computer-generated frequency dispersion curves of the dielectric coefficients, power reflectance, brightness temperature, and skin depth of water as a function of eight different normalities of sodium chloride, corresponding to a salinity range from pure to ocean water and as a function of five different temperatures from 0C to 40C to the radio frequency range from 10 to the 6th to 3 x 10 to the 10th power Hertz were constructed. A laboratory prototype radio reflection spectrometer was designed and assembled from commercially available swept-frequency UHF microwave test equipment, a single horn antenna, and a hand-made coaxial sample cell. Author (GRA)

N73-31287*# National Marine Fisheries Service, Bay Saint Louis, Miss. Fisheries Engineering Lab.

INVESTIGATION USING DATA FROM ERTS TO DEVELOP AND IMPLEMENT UTILIZATION OF LIVING MARINE RESOURCES Progress Report, 20 Jul. - 10 Sep. 1973

William H. Stevenson, Principal Investigator and Edward J. Pastula, Jr. Sep. 1973 4 p ref ERTS

(NASA Order S-70246-AG)

(E73-10980; NASA-CR-133759; PR-6) Avail: NTIS HC \$3.00 CSCL 08A

N73-31291*# Army Engineer Waterways Experiment Station, Vicksburg, Miss.

SEDIMENT PATTERN CORRELATION WITH INFLOW AND TIDAL ACTION Progress Report, 1 Jul. - 31 Aug. 1973

Warren E. Grabau, Principal Investigator 13 Sep. 1973 3 p ERTS

(NASA Order S-70259-AG)

(E73-10984; NASA-CR-133763) Avail: NTIS HC \$3.00 CSCL 08C

N73-31303*# National Marine Fisheries Service, Bay Saint Louis, Miss.

APPLICATION OF REMOTE SENSING FOR FISHERY RESOURCE ASSESSMENT AND MONITORING Monthly Progress Report, 10 Aug. - 10 Sep. 1973

05 OCEANOGRAPHY AND MARINE RESOURCES

William H. Stevenson, Principal Investigator 12 Sep. 1973 3 p EREP
(NASA Order T-8217-B)
(E73-10997; NASA-CR-133778; MPR-4) Avail: NTIS HC \$3.00 CSCL 08A

N73-31311*# International Imaging Systems, Mountain View, Calif.
OCEAN WATER COLOR ASSESSMENT FROM ERTS-1 RBV AND MSS IMAGERY Progress Report, 8 Jul. - 7 Sep. 1973
D. S. Ross, Principal Investigator 7 Sep. 1973 13 p ERTS
(Contract NAS5-21862)
(E73-11006; NASA-CR-133799; C200-3) Avail: NTIS HC \$3.00 CSCL 08J

N73-31319*# Long Island Univ., Greenvale, N.Y. Science Engineering Research Group.
IN SITU SPECTRORADIOMETRIC CALIBRATION OF EREP IMAGERY AND OCEANOGRAPHY OF BLOCK ISLAND SOUND Monthly Progress Report, Sep. 1973
Edward Yost, Principal Investigator 20 Sep. 1973 3 p EREP
(Contract NAS9-13308)
(E73-11015; NASA-CR-133811) Avail: NTIS HC \$3.00 CSCL 08J

N73-31335*# Earth Satellite Corp., Washington, D.C.
APPLICATION OF ERTS-1 DATA TO THE PROTECTION AND MANAGEMENT OF NEW JERSEY'S COASTAL ENVIRONMENT Progress Report, period ending 31 Aug. 1973
Roland S. Yunghans, Edward B. Feinberg, Frank J. Wobber, Robert L. Mairs, Principal Investigators, Robert T. Macomber, and Dennis Stanczuk 12 Sep. 1973 12 p Prepared for N. J. Dept. of Environ. Protect. ERTS
(Contract NAS5-21765)
(E73-11031; NASA-CR-133864) Avail: NTIS HC \$3.00 CSCL 08J

The author has identified the following significant results. Rates of erosion and accretion of the shoreline are being calculated for two test areas along the New Jersey coast. Measurements are made on aerial photographs taken over the last 20 years and processed by computer. The rates are presented in graphic form on an ERTS-1 base map at a scale of 1:125,000. These rates are being used to determine the effectiveness of various shore protection structures at preventing sand removal and encouraging sand accumulation. Information on maintenance and construction expenditures is being used to obtain a cost effectiveness ratio for various shore protection devices. The relationship of erosion rates, property value, and project cost are all criteria for selection of site type and extent of a shore protection structure. Compilation and evaluation of historical data will identify past decision making patterns. The effectiveness of these decisions with respect to erosion rates, property value, and project cost, can be used as an added criteria for future allocation of money and the selection of site and type of structure to be built.

N73-31341*# Environmental Research and Technology, Inc., Lexington, Mass.
EVALUATE THE APPLICATION OF ERTS-A DATA FOR DETECTING AND MAPPING SEA ICE Bimonthly Progress Report, 10 Jul. - 10 Sep. 1973
James C. Barnes, Principal Investigator 27 Sep. 1973 6 p ERTS
(Contract NAS5-21802)
(E73-11037; NASA-CR-133883; BMPR-5) Avail: NTIS HC \$3.00 CSCL 08L

The author has identified the following significant results. The results of the analysis of data collected during the spring and summer demonstrate that ERTS-1 imagery has a high potential for monitoring arctic sea ice conditions during the time for

maximum ice extent through ice-breakup season. In the eastern Beaufort Sea area, the combination of ERTS-1 orbital overlap and a high incidence of cloud-free conditions during the spring assures a high frequency of repetitive satellite coverage. In the mid-Beaufort Sea, numerous fractures and leads can be identified, even in the early spring data. Ice features that can be identified include: development of fractures leading to the formation of distinct ice floes; growth and deterioration of leads; evidence of shearing movements of ice masses; formation of new grey ice within leads; distinction between grey, grey-white, and older forms of ice; and the deterioration of the ice surface evidenced by the formation of puddles, thaw holes, and drainage patterns. Ice conditions in the Bering Sea near St. Lawrence Island reported by aircraft observers participating in the Bering Sea Expedition are in close agreement with the ice conditions mapped from the corresponding ERTS-1 imagery. Ice features identified were: boundaries between grey ice and first year ice, shear leads, and occurrence of open water.

N73-31355*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
RESEARCH NEEDS IN OCEAN COLOR DATA ANALYSIS
W. R. McCluney Sep. 1973 17 p refs.
(NASA-TM-X-70466; X-652-73-261) Avail: NTIS HC \$3.00 CSCL 08J

The success of the effort to extract several subsurface oceanographic parameters from remotely sensed ocean color data will depend to a great extent upon the existence of adequate theoretical models relating the desired oceanographic parameters to the upwelling radiances to be observed. In order to guide the development of these models, and to check their accuracies, a considerable amount of experimental work must be performed. The theoretical and experimental work needed to develop techniques for the quantitative analysis of satellite ocean color data is described.
Author

N73-31389# Scripps Institution of Oceanography, San Diego, Calif. Marine Physical Lab.
INFRARED RADIOMETRY AND AIR/SEA INTERACTION STUDIES Final Report, 10 Nov. 1971 - 9 Mar. 1973
Theodore D. Foster and Stephen Rearwin 1973 6 p refs
(Contract N00014-69-A-0200-8032)
(AD-763788) Avail: NTIS CSCL 08/10

The report describes research conducted on improving and evaluating an airborne two-wavelength radiometer to make direct measurements of the sea-surface temperature and the total heat flux through the sea surface.
GRA

N73-31902* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
REMOTE SENSING OF SEA ICE MOTION
Albert Rango *In its* Significant Accomplishments in Sci. 1973 p 182-186 ref
CSCL 08L

N73-31904* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
OCEANIC TURBIDITY AND CHLOROPHYLL AS INFERRED FROM ERTS-1 OBSERVATIONS
Robert J. Curran *In its* Significant Accomplishments in Sci. 1973 p 190-192
CSCL 08J

N73-32226*# Alaska Univ., Fairbanks.
SEA, ICE AND SURFACE WATER CIRCULATION, ALASKAN CONTINENTAL SHELF Bimonthly Progress Report
F. F. Wright, G. D. Sharma, and J. J. Burns, Principal Investigators 30 Sep. 1973 5 p Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(Contract NAS5-21833)

(E73-11050; NASA-CR-133871; BMPR-7) Avail: NTIS HC \$3.00 CSCL 08L

The author has identified the following significant results. Salinity and temperature measurements in the Bering Sea indicate that the Yukon River outflow extends as far as 200 km from its mouth. The fresh water flow from the Yukon River flows north and east into Norton Sound. Various levels of suspended sediment concentration in waters have been successfully color coded using a VP-8 color density slicing image analyzer. The 70 mm negative transparencies have provided the best fit for the ground truth observations.

N73-32240* Alaska Univ., Fairbanks. Inst. of Marine Science.

CIRCULATION OF PRINCE WILLIAM SOUND Bimonthly Progress Report

Robin D. Muench, Principal Investigator 30 Sep. 1973 2 p ERTS

(Contract NAS5-21833)

(E73-11064; NASA-CR-135520; BMPR-7) Avail: NTIS HC \$3.00 CSCL 08C

N73-32262* National Oceanic and Atmospheric Administration, Miami, Fla. Atlantic Oceanographic and Meteorological Labs.

REMOTE SENSING OF OCEAN CURRENT BOUNDARY LAYER Monthly Progress Report, Sep. 1973

George A. Maul, Principal Investigator Sep. 1973 2 p EREP (NASA Order T-4713-B)

(E73-11095; NASA-CR-135563; MPR-3) Avail: NTIS HC \$3.00 CSCL 08C

N73-32311* Oregon State Univ., Corvallis. School of Oceanography.

MULTISPECTRAL SCANNER STUDIES OF THE OCEAN OFF THE OREGON COAST Final Report

W. Percy Jun. 1973 69 p refs

(Contract N62306-70-C-0414)

(AD-763428) Avail: NTIS CSCL 08/10

The objectives of this study were to learn how the radiances of backscattered light of different bandwidths (1) change with distance offshore, (2) correlate with infrared measurements of sea surface temperature, and (3) vary among and within Columbia River plume, upwelled and oceanic waters. In general, color patterns were highly correlated with sea surface temperatures. Nevertheless, some color features were found that indicated more about the age and advection of water than could be inferred from study of temperatures alone. Color variations in the region of the plume were frequently complex and highly structured. Numerous problems developed in the analysis and interpretation of the scanner data that proved difficult to solve and limited the general applicability of the system for quantitative study of ocean color. GRA

N73-33233 New York Univ., N.Y. School of Engineering and Science.

THE OPTIMUM USE OF INFRARED DATA AS OBTAINED FROM METEOROLOGICAL AND OCEANOGRAPHIC APPLICATIONS Ph.D. Thesis

Ming-Dah Chow 1973 106 p

Avail: Univ. Microfilms Order No. 73-19382

Methods are developed for determining sea surface temperatures, temperature soundings, and humidity soundings from infrared data as obtained from satellites. Temperature soundings are corrected directly according to the ratio of the measured and calculated radiances, while humidity soundings are corrected inversely according to the ratio of these radiances. In addition, ratios of measured and calculated radiances are amplified by small gain factors to reduce the computing time. The solutions are very stable with respect to errors introduced in the measured radiances. The effect of random errors are reduced by a weighted average. An iterative scheme for determining

successively the sea surface temperature, temperature sounding, humidity sounding, and then back to the sea surface temperature, and so on, is also discussed. By using the inverted temperatures and humidities, the geopotential heights at ten pressure levels, the infrared losses from the sea surface, and the cooling rates in the atmosphere are also calculated. The results are very close to those calculated from the observed temperatures and humidities. Dissert. Abstr.

N73-33256* Geological Survey, Menlo Park, Calif.

PRINCIPAL SOURCES AND DISPERSAL PATTERNS OF SUSPENDED PARTICULATE MATTER IN NEARSHORE SURFACE WATERS OF THE NORTHEAST PACIFIC OCEAN AND SEASONAL VARIATION IN SNOW COVER IN THE SIERRA NEVADA Progress Report, 1 Jun. - 15 Aug. 1973

Paul R. Carlson, Principal Investigator and Deborah R. Harden 20 Aug. 1973 14 p refs ERTS

(NASA Order S-70243-AG-7)

(E73-11099; NASA-CR-135568) Avail: NTIS HC \$3.00 CSCL 08J

The author has identified the following significant results. ERTS-1 imagery used in conjunction with the surface-drift cards indicated a southerly flow direction of the central California near surface coastal currents during mid-June 1973. The near-surface currents off northern California and southern Oregon were more complex. Some drift cards were recovered north and some south of their release points; however, the prevalent direction of flow was northerly. General agreement in flow direction of coastal currents obtained from ERTS-1 imagery and drift card data reinforces the image interpretation. Complete seasonal coverage of nearshore circulation interpreted from ERTS-1 imagery will provide information necessary for proper coastal zone management. Extent of snow cover can be readily delimited on ERTS-1 band 5. In the central Sierra Nevada Mountains this past winter season, the snow line, as recorded by ERTS-1, reached an elevation of less than 1500 meters in January but had melted back to between 2500 and 3000 meters by the end of May. ERTS-1 imagery seems to provide sufficient resolution to make it a useful tool for monitoring changes in snow cover in the Sierra Nevada Mountains. Author

N73-33290* National Marine Fisheries Service, Bay Saint Louis, Miss.

APPLICATION OF REMOTE SENSING FOR FISHERY RESOURCE ASSESSMENT AND MONITORING Monthly Progress Report, 10 Sep. - 10 Oct. 1973

W. H. Stevenson, Principal Investigator 12 Oct. 1973 3 p EREP

(NASA Order T-8217-B)

(E73-11135; NASA-CR-135682; MPR-5) Avail: NTIS HC \$3.00 CSCL 08A

N73-33300* Delaware Univ., Newark. Coll. of Marine Studies.

APPLICATION OF ECOLOGICAL, GEOLOGICAL AND OCEANOGRAPHIC ERTS-1 IMAGERY TO DELAWARE'S COASTAL RESOURCES PLANNING: COASTAL VEGETATION, LAND USE, AND ENVIRONMENTAL IMPACT MAPPING

V. Klemas, Principal Investigator [1973] 2 p ERTS

(Contract NAS5-21837)

(E73-11146; NASA-CR-135734) Avail: NTIS HC \$3.00 CSCL 08J

N73-33301* Delaware Univ., Newark. Coll. of Marine Studies.

APPLICATION OF ECOLOGICAL, GEOLOGICAL AND OCEANOGRAPHIC ERTS-1 IMAGERY TO DELAWARE'S COASTAL RESOURCES PLANNING: MONITORING WATER PROPERTIES AND MOVEMENTS - TURBIDITY, COLOR, BOUNDARIES, CIRCULATION, POLLUTION DISPERSION

V. Klemas, Principal Investigator [1973] 3 p ERTS

(Contract NAS5-21837)

05 OCEANOGRAPHY AND MARINE RESOURCES

N73-33307* Army Cold Regions Research and Engineering Lab., Hanover, N.H.

MESOSCALE DEFORMATION OF SEA ICE FROM SATELLITE IMAGERY

Duwayne M. Anderson, Principal Investigator, W. K. Crowder, H. L. McKim, S. F. Ackley, and W. D. Hibler, III 25 Oct. 1973 2 p Proposed for presentation at the Interdisciplinary Symp. on Advanced Concepts and Tech. in the Study of Snow and Ice Resources, Monterey, Calif., 2-6, Dec. 1973 ERTS

(NASA Order S-70253-AG)

(E73-11153; NASA-CR-135741) Avail: NTIS HC \$3.00 CSCL 08L

N73-33308* Old Dominion Univ. Research Foundation, Norfolk, Va. Dept. of Biology.

THE USE OF ERTS-1 TO MORE FULLY UTILIZE AND APPLY MARINE STATION DATA TO THE STUDY OF PRODUCTIVITY ALONG THE EASTERN SHELF EXPANDED WATERS OF THE UNITED STATES Bimonthly Report, 1 Aug. - 31 Sep. 1973

Harold G. Marshall, Principal Investigator 31 Sep. 1973 2 p ERTS

(Contract NAS5-21816)

(E73-11154; NASA-CR-135742) Avail: NTIS HC \$3.00 CSCL 08G

N73-33311* National Marine Fisheries Service, Bay Saint Louis, Miss. Fisheries Engineering Lab.

SKYLAB OCEANIC GAMEFISH PROJECT FIELD OPERATIONS REPORT, 2 JULY - 10 AUGUST 1973

W. H. Stevenson and E. G. Woods, Principal Investigators 28 Sep. 1973 64 p refs EREP

(NASA Order T-8217-B)

(E73-11157; NASA-CR-135745) Avail: NTIS HC \$5.25 CSCL 08G

N73-33317* Delaware Univ., Newark. Coll. of Marine Studies.

MONITORING COASTAL WATER PROPERTIES AND CIRCULATION FROM ERTS-1 Report on Significant Results

V. Klemas, Principal Investigator 30 Oct. 1973 4 p refs ERTS

(Contract NAS5-21837)

(E73-11164; NASA-CR-135758) Avail: NTIS HC \$3.00 CSCL 08C

N73-33328* National Environmental Satellite Service, Washington, D.C. Spacraft Oceanography Group.

SKYLAB EARTH RESOURCES EXPERIMENT PACKAGE EXPERIMENTS IN OCEANOGRAPHY AND MARINE SCIENCE

A. L. Grabham and John W. Sherman, III Sep. 1973 79 p refs

(NOAA-TM-NESS-51) Avail: NTIS HC \$6.00

A reference for marine scientists for coordination and exchange of information in connection with the Skylab Earth Resources Experiment Package (EREP) missions of 1973 is presented. The experiments planned, the experiment package used, the methods for handling data, and the schedule for ships for potential ocean ground truth data are listed and described.

Author

N73-33333* Linguistic Systems, Inc., Cambridge, Mass.

THE FRALIT PROGRAM (ERTS-1): A REPORT PREPARED FOR THE OCCASION OF THE THIRTIETH INTERNATIONAL

AERONAUTICS AND SPACE EXHIBITION

P. DeMathieu and F. Verger Washington NASA Oct. 1973 34 p refs Transl. into ENGLISH of the publ. "Le Programme Fralit (ERTS-1): Notice preparee a l'occasion du 30eme Salon International de l'Aeronautique et de l'Espace" France, Le Bourget, May 1973 28 p

(Contract NASw-2824)

(NASA-TT-F-15063) Avail: NTIS HC \$3.75 CSCL 05A

Under the FRALIT (French Atlantic Littoral) project, the result of collaboration between three French institutions and NASA, French laboratories are studying and reporting on records derived from ERTS-1. Marshy ocean coast areas and sedimentary material in the water bordering these areas are being studied. The records include digitized magnetic tape and composite color printing. Data are furnished in four spectral bands for each unit area, enabling increasingly complex charts to be prepared. The initial results on shoreline deposits, geomorphology of the inlets, and geography of the salt marshes were productive. Author

N73-33360* Naval Research Lab., Washington, D.C.

DETERMINATION OF OCEAN SURFACE DESCRIPTORS USING SEA PHOTO ANALYSIS TECHNIQUES Final Report

Roger O. Pilon 18 Jul. 1973 39 p

(Contract DOT-FA71WAI-220)

(AD-764858; NRL-7574) Avail: NTIS CSCL 08/3

The techniques of Sea Photo Analysis have been used to obtain surface truth descriptors of the open ocean from an aircraft. Aerial photographs were taken such that the density fluctuations of the negatives were related to surface slope. The slope spectra, obtained by Fourier analysis of the negatives, were fitted to an equivalent form of the Pierson-Moskowitz wave height spectrum. The photographs, the wave height spectrum, and the rms slope equations determined by Cox and Munk then yielded the averaged heading of the waves, the equivalent wind speed, the rms wave height, and the rms slope for clean and slick surfaces. The optical techniques of Sea Photo Analysis used in this program and digital analysis, used when whitecaps were present in the photographs, are discussed. The empirical equations used to determine rms wave height and slope and auxiliary rms slope and wave height spectrum equations are given. Surface descriptors were inferred for seas driven by winds from 3 to 21 knots occurring on 16 separate days. Author (GRA)

N73-33542* Kansas Univ. Center for Research, Inc., Lawrence.

A NONCOHERENT MODEL FOR MICROWAVE EMISSIONS AND BACKSCATTERING FROM THE SEA SURFACE

S. T. Wu and A. K. Fung Washington NASA Nov. 1973 36 p refs

(Contract NAS1-10048)

(NASA-CR-2326; TR-186-3) Avail: NTIS HC \$3.00 CSCL 20N

The two-scale (small irregularities superimposed upon large undulations) scattering theory proposed by Semyonov was extended and used to compute microwave apparent temperature and the backscattering cross section from ocean surfaces. The effect of the small irregularities upon the scattering characteristics of the large undulations is included by modifying the Fresnel reflection coefficients; whereas the effect of the large undulations upon those of the small irregularities is taken into account by averaging over the surface normals of the large undulations. The same set of surface parameters is employed for a given wind speed to predict both the scattering and the emission characteristics at both polarizations. Author

N73-33543* Kansas Univ. Center for Research, Inc., Lawrence.

BACKSCATTERING FROM A TWO-SCALE ROUGH SURFACE WITH APPLICATION TO RADAR SEA RETURN

H. L. Chan and A. K. Fung Washington NASA Nov. 1973 69 p refs

(Contract NAS1-10048)

(NASA-CR-2327; TR-186-4) Avail: NTIS HC \$3.50 CSCL

20N

A two-scale composite surface scattering theory was developed without using the noncoherent assumption. The surface is assumed electrically homogeneous and finitely conducting; the surface roughness may be nonuniform geometrically. The special forms of the terms for excluding the non-coherent assumption and the meanings of these terms are discussed. To gain insight into the mechanisms of backscattering, the results are compared with those obtained by previous theories. The comparison with NRL data shows satisfactory agreement for both horizontal and vertical polarization, especially for incident angles larger than 30 deg. For smaller incident angles, NASA/JSC data have been chosen for comparison and close agreement is again observed.

Author

06. HYDROLOGY AND WATER MANAGEMENT

Includes snow cover and water runoff in rivers and glaciers, saline intrusion, drainage analysis, geomorphology of river basins, land uses, and estuarine studies.

A70-24741 Determination of water depth by remote measurement of reflectance of underwater plants in the near-infrared. D. L. Spooner and L. R. Lankes (Lockheed Electronics Co., Houston, Tex.). In: American Society of Photogrammetry, Annual Meeting, 36th, Washington, D.C., March 1-6, 1970, Technical Papers. Falls Church, Va., American Society of Photogrammetry, 1970, p. 422-434.

Description of a remote sensing system for depth determination using differential wavelength effects of underwater plants in the near infrared. The overall levels of the reflectance of plant leaves were examined on a spectral basis subject to the effects of lighting geometry, variations in illumination, and changes in water path length. The differences caused by changes in water path length are particularly significant at wavelengths greater than 0.8 micron. The method should prove useful in monitoring the hydrology of swamps and marshlands. In a calibrated system, the possibility of using measured departures from known values as a measure of pollution content is also considered. Greater depth ranges should be possible by extending into the visible region of the spectrum. T.M.

A70-24742 * Applications of multispectral data collection and processing techniques applied to hydrobiological investigations in Everglades National Park, Florida. Aaron L. Higer, Milton C. Kolipinski (U.S. Geological Survey, Miami, Fla.), Norma S. Thomson, and Fred J. Thomson (Michigan, University, Ann Arbor, Mich.). In: American Society of Photogrammetry, Annual Meeting, 36th, Washington, D.C., March 1-6, 1970, Technical Papers. Falls Church, Va., American Society of Photogrammetry, 1970, p. 437-470. NASA-supported research.

The Water Resources Division of the U.S. Geological Survey, in cooperation with NASA, as part of the EROS program is testing the applicability of remote-sensing techniques to the mapping and evaluation of water resources in the Everglades of Florida. Mapping of hydrobiological features with multiband scanner imagery was tried for the first time in September of 1967 in the Everglades National Park on a strip of land eight miles long and 2,000 ft wide. This was done by electrically processing selected combinations of video signals in the narrow spectral bands between 0.4 and 1.0 micron (micrometers) to obtain recognition maps for tree islands, emergent aquatic grassland, and various surface-water depths. The computer recognition maps of individual hydrobiological features were printed in different colors and superposed to provide a color composite map of the area. Periodic data collection and processing in this form would yield quantitative data concerning the direction and extent of plant successional changes in the park. This in turn would provide more accurate information for water management practices in the park. This technique has potential for use in the hydrobiological evaluation of marsh, swamps and other shallow-water areas. (Author)

A70-24750 Discharge properties of drainage basins observable from aerial photographs. Steven Istvan Majtenyi (Tippett-Abbott-McCarthy-Stratton, New York, N.Y.) and Donald J. Belcher (Cornell University, Ithaca, N.Y.). In: American Society of Photogrammetry, Annual Meeting, 36th, Washington, D.C., March 1-6, 1970, Technical Papers. Falls Church, Va., American Society of Photogrammetry, 1970, p. 583-595. 8 refs.

Investigation of the utility scope of aerial photography in analyses of the discharge properties of drainage basins. The discharge of drainage basins is composed of water collected from surface runoff and subsurface flow. The possibility of underground water

movement can be predicted from aerial photographs but cannot be evaluated in a quantitative manner. The long term discharge due to surface runoff can be related to the climatic conditions and the drainage density in mature landforms. Aerial photographs are prominent in the evaluation of the drainage density because they show more details than any map, and they provide a means for the selection of those channels which reflect the long term infiltration properties of soils and rocks. M.V.E.

A70-26939 * # Hydrologic communications experiment on the Applications Technology Satellite (ATS-1). Allen F. Flanders, Francis V. Kohl, and Thomas W. Davis (ESSA, U.S. Weather Bureau, Silver Spring, Md.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 1.

Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 197-204. NASA-supported research.

In a combined ESSA/NASA experiment, hydrologic data relay and equipment configuration testing was conducted via the VHF transponder on board the geostationary NASA Applications and Technology Satellite (ATS-1). Digital river and rainfall data were transmitted from hydrologic platforms in Arkansas, California, and Oregon upon satellite relayed interrogation by the NASA Command and Data Acquisition (CDA) station at Mojave, California. The data messages, relayed through the satellite, were recorded at Mojave, and transmitted to the Weather Bureau's Office of Hydrology in Silver Spring, Md., for teleprinter readout. (Author)

A70-30138 # Utilization of television data from meteorological earth satellites for hydrological purposes (Ispol'zovanie televizionnoi informatsii meteorologicheskikh sputnikov zemli v gidrologicheskikh tseliakh). S. N. Ternikov (Sredneazitskii Nauchno-Issledovatel'skii Gidrometeorologicheskii Institut, Tashkent, Uzbek SSR). *Meteorologiya i Gidrologiya*, Mar. 1970, p. 58-64. 11 refs. In Russian.

Development of a method of processing and analyzing TV pictures obtained from meteorological satellites with the aim of obtaining hydrological information. Solutions to problems associated with snow and ice hydrology are examined, with particular reference to the interpretation of snow photographs, allowance for the difference in picture size in the determination of snow areas, and the tying-in of photographs for use in hydrological applications. Particular attention is given the assessment of errors arising in the tying-in of photographs and in the determination of snow areas when using various picture processing techniques. V.P.

A70-31238 * Snowfield mapping with K-band radar. William P. Waite and Harold C. MacDonald (Kansas, University, Lawrence, Kan.). *Remote Sensing of Environment*, vol. 1, Mar. 1970, p. 143-150. 13 refs. Grant No. DA-AK-02-68-C-0089; Contract No. NAS 9-7175.

Discussion of the prospects of snow detection on K band radar imagery, with an attempt to define the factors influencing radar return signals from snow-covered surfaces as compared to signal returns from surrounding terrains. Indications are found that volume scattering, not simply the moisture content, is largely responsible for the significant increase in signal returns observed for old snow. It is suggested that the structure of metamorphosed snow not only affects the form factor of the dielectric mix of ice and air but has also some other effects on signal returns. Hence, the necessity of a more complex microwave signal return model for monitoring the volume and quality of snowfields and icefields by K band radar is indicated. V.Z.

A70-39063 Space acquired data - Hydrological requirements. Paul Bock (Connecticut, University, Storrs, Conn.). In: Princeton University, Conference on Aerospace Methods for Revealing and Evaluating Earth's Resources, Princeton University, Princeton, N.J., September 25, 26, 1969, Proceedings.

Edited by J. P. Layton. Princeton, N.J., Princeton University Conference, 1970, p. 14.1-14.6; Discussion, p. 14.7, 14.8.

06 HYDROLOGY AND WATER MANAGEMENT

Consideration of the hydrological cycle, which relates to the occurrence and movement of water in the atmosphere and within the surface mantle of the earth. The premise is that both the science of hydrology and the applications of such knowledge are data-dependent in a very real sense. Research and practical aspects of hydrology have imposed data requirements which have not been met using the classical techniques. Present remote sensing techniques from satellites can provide essential information not now available. Space applications provide a strong rationale for unifying both the theoretical and observational development of hydrology and for bringing hydrology together with other earth sciences. F.R.L.

A70-39066

A water management model using earth resources satellites. Allan H. Muir (Earth Satellite Corp., Washington, D.C.). In: Princeton University, Conference on Aerospace Methods for Revealing and Evaluating Earth's Resources, Princeton University, Princeton, N.J., September 25, 26, 1969, Proceedings.

Edited by J. P. Layton. Princeton, N.J., Princeton University Conference, 1970, p. 19.1-19.15.

Review of a systems analysis study that defines a complex and stringent set of requirements for an earth resources information system using satellite-based remote sensors, that developed a concept for a satellite-assisted information system to meet these requirements that appears to be technically feasible for the mid-1970's, and that evaluated the costs and benefits of deploying such a satellite system operationally. It is considered that the study demonstrates that substantial benefits can be realized from a satellite system capability such as that outlined, and that the methodology developed is applicable and appropriate to analysis of other major areas of information needs for earth resources management. F.R.L.

A70-45362 *

Flood plain delineation with pan and color. Dale E. Parker, Gerhard B. Lee, and Clarence J. Wilfred (Wisconsin, University, Madison, Wis.). *Photogrammetric Engineering*, vol. 36, Oct. 1970, p. 1059-1063. 7 refs. NASA-supported research; U.S. Department of the Interior Grant No. B-002-Wisc.

Study of the placement of rare flood boundaries derived by interpretation of panchromatic and color aerial photographs along a stream in a glaciated area of southern Wisconsin. The accuracy of these boundaries was determined by comparison at 29 cross sections with those of an Intermediate Regional Flood plotted by the U.S. Army Corps of Engineers. Boundaries on both types of photography agreed with the engineering boundary at 28% of the cross sections, were within 100 feet at 67% of the cross sections, and within 300 feet at 95% of the cross sections. Flood plain boundaries were most accurately delineated where physiographic landforms were well defined. The results indicate that airphoto interpretation can be a useful tool to delineate flood plain boundaries where the lack of hydrologic data, time, and funds prohibit plotting boundaries by traditional engineering methods. O.H.

A70-45979 *

An airborne measurement of the salinity variations of the Mississippi River outflow. J. D. Droppleman, R. A. Mennella (Lockheed Aircraft Corp., Houston, Tex.), and D. E. Evans (NASA, Manned Spacecraft Center, Houston, Tex.). *Journal of Geophysical Research*, vol. 75, Oct. 20, 1970, p. 5909-5913.

Passive microwave radiometric measurement of salinity variations at the south and southwest passes of the Mississippi River on Sept. 27, 1969. The passive microwave system mounted on the NASA/MSC P3A aircraft can measure radiometric energy in four bands centered on 1.4, 10.6, 22.2, and 31.4 GHz. No radiometric temperature change (within instrumental limits) was observed with the 10.6-, 22.2-, or the 31.4-GHz radiometers. However, a radiometric change of 13 to 18 K was observed with the 1.4-GHz radiometer. This observed change and the absence of an observed change by the other channels agrees (within experimental limits) with the theoretically predicted radiometric temperature variation for water at 25 C. This measurement demonstrates that an airborne passive microwave radiometer operating at 1 to 1.5 GHz can rapidly measure salinity and variations in salinity over large areas. (Author)

A71-15290

Nimbus satellite views hydrologic conditions. George Rabchevsky (Allied Research Associates, Inc., Lanham, Md.). In: Space sciences - Future applications for mankind; Vandenberg Scientific and Technical Societies Council, Western Space Congress, 1st, Santa Maria, Calif., October 27-29, 1970, Proceedings. Part 1. North Hollywood, Calif., Western Periodicals Co., 1970, p. 200-221. 53 refs.

Examination of the feasibility of applying Nimbus meteorological sensor data to hydrology and related studies. Two case studies are presented, exemplifying the satellites' ability of repetitive observations which make it possible to monitor phenomena under special conditions. One case deals with changes observed in the Arctic ice, utilizing the Nimbus 2 and 3 television picture data. The other study deals with terrestrial changes in the Mississippi River Valley and the Niger River Valley, observed primarily in the 0.7 to 1.3 micron spectral band. Observed tonal variations are brought about by the soil moisture and vegetation boundary changes that correlate with regional climatic and meteorological conditions. Z.W.

A71-22644

Radio-wave method for geophysical prospecting. E. Bahar (Nebraska, University, Lincoln, Neb.). *Journal of Geophysical Research*, vol. 76, Mar. 10, 1971, p. 1921-1928. 21 refs. Research supported by the University of Nebraska and ESSA.

The problem of ground wave propagation over a nonuniform overburden with arbitrarily varying complex dielectric coefficient and depth is analyzed. Using a full wave approach, the effects of the nonuniform overburden upon the surface wave and the radiation field are examined. The criteria for distinguishing between the effects of variations of the overburden depth and variations of its complex dielectric coefficient are determined. In particular, the feasibility of using radio-wave measurements to map the water table and the overburden conductivity is explored. (Author)

A71-23217

Evidences of ground-water flow into the Lehigh River, Pennsylvania. Charles R. Wood (U.S. Geological Survey, Water Resources Div., Harrisburg, Pa.). In: American Society of Photogrammetry, Annual Meeting, 37th, Washington, D.C., March 7-12, 1971, Technical Papers. Falls Church, Va., American Society of Photogrammetry, 1971, p. 245-257.

Demonstration that thermal infrared imagery, which displays temperature differences, can be used to identify ground water discharge. Much ground water with a nearly constant temperature of about 12 C is discharged from a limestone aquifer to the Lehigh River throughout the year. Previously unlocated ground water discharges were detected by a Reconofax IV infrared imager which senses in the 8 to 14 micrometer bandwidth. Springs with flows as little as 1 gpm were detected on predawn imagery. The cold areas on the infrared image were not indicative of the quantity of water being discharged. Although the data used were acquired from aircraft, the usefulness of similar data from an orbital satellite was considered. F.R.L.

A71-23218

Photographic analyses of water resource color and quality. Kenneth R. Piech and J. E. Walker (Cornell Aeronautical Laboratory, Inc., Buffalo, N.Y.). In: American Society of Photogrammetry, Annual Meeting, 37th, Washington, D.C., March 7-12, 1971, Technical Papers. Falls Church, Va., American Society of Photogrammetry, 1971, p. 258-279. 20 refs. Research supported by the Cornell Aeronautical Laboratory.

Further development of the previously described (1971) scene color standard (SCS) technique for obtaining accurate aerial photographic measurements of terrain spectral reflectance without the necessity for preplaced ground control reflectances. The technique can provide photometric information for engineering analyses. The relationship of water reflectance to quality is discussed, and an example of the value of photometric data in determining flooded acreage from a satellite photograph is presented. F.R.L.

A71-36362

Remote sensors for hydrogeologic prospecting in arid terrains. E. G. Wermund. *IEEE Transactions on Geoscience Electronics*, vol. GE-9, July 1971, p. 120-130. 20 refs.

Description of an experimental test in which results of remote sensing are presented for four arid areas in the western U.S.: Railroad Valley and the Las Vegas Basin in Nevada, Death Valley in California, and the Hueco Mountains in Texas. In the test the primary remote sensors are the IR line scanner, 8-14 microns, and a 13.7-GHz microwave radiometer; color and color IR photography are secondary sensors. The altitude best for hydrogeologic data collection is examined. Results of the study show that IR color photography is sensitive to changes in plant communities reflecting concentrations of near surface water. Signatures of near-surface water concentration are contained in 8-14 micron IR and 13.7-GHz microwave radiometer data. M.M.

A72-11800 # Environmental analysis of the Lake Tahoe Basin from small scale multispectral imagery. P. T. Tueller and G. Lorain (Nevada, University, Reno, Nev.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 453-467. 11 refs. Research supported by the U.S. Geological Survey.

A preliminary evaluation has been made of the utility of small-scale color, color infrared and multispectral aerial imagery in the Lake Tahoe Basin, California, Nevada, for making environmental modification studies. First, environmental and cultural features have been identified and quantified on color infrared film at a scale of 1:108,000. Second, the usefulness of various film-filter combinations has been analyzed at smaller scales (1:432,000). These film-filter combinations and scales were compared in an attempt to screen both static and dynamic features which require a certain scale and band or combination of bands for identification and measurement. False color renditions were found to be useful for increasing the ease of extracting certain kinds of information. O.H.

A72-11805 # Lake ice surveillance via airborne radar - Some experimental results. B. T. Larrowe, R. B. Innes, R. A. Rendleman, and L. J. Porcello (Michigan, University, Ann Arbor, Mich.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 511-521.

Fine-resolution radar images of Great Lakes ice forms were generated experimentally, to determine their capability for ice type classification. The images are substantially free of scanning-line structure and radar speckle. The temperate-zone fresh-water ice observed differs from the arctic sea ice imaged in earlier reported ice-surveillance programs. Images showing several ice forms and some land features are included. (Author)

A72-11812 # A method for calculating water depth attenuation coefficients and bottom reflectance characteristics. W. L. Brown, F. C. Polcyn, and S. R. Stewart (Michigan, University, Ann Arbor, Mich.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 663-682.

Multispectral scanner data collected over the shoreline of Lake Michigan were analyzed by computer for obtaining water depth measurements in the vicinity of Bridgman, Mich. Further analysis indicated that data on water attenuation and bottom reflectance could be extracted directly from the multispectral scanner data. Data are presented on attenuation coefficients and bottom reflectance characteristics for a test site where the depth varied from 2 to 28 ft. It is shown that the water attenuation coefficients are a function of position in the scene, leading to possible by-product information on suspended particulate matter and turbidity. This information is important for measuring water depth on a large-area basis, for monitoring discharges into the water, for determining concentrations of suspended materials, and other observations where water properties are significant. M.M.

A72-11832 # Microwave emission from snow - A progress report. M. F. Meier (U.S. Geological Survey, Tacoma, Wash.) and A. T. Edgerton (Aerojet-General Corp., El Monte, Calif.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 2. Ann Arbor, University of Michigan, 1971, p. 1155-1163.

Evaluation of measurements of natural and artificial snowpacks at 21-, 6-, 2.2-, and 0.8-cm wavelengths, showing that brightness temperatures vary with snow depth, water equivalent, free water content, and the character of the underlying material. A direct relationship exists between the water equivalent of dry snow and the microwave brightness temperature. Laboratory measurements of electrical properties of snow have been used to develop numerical models of microwave emission properties as a function of snow depth, wetness, density, layering, and base material using Sogryn's layered medium theory. Numerical results agree well with field results for wet snow, but the agreement is only qualitative for dry snow. (Author)

A72-11884 # Environmental radiation surveys and snow mass predictions from aircraft. L. J. Deal (AEC, Division of Biology and Medicine, Washington, D.C.), J. F. Doyle, Z. G. Burson, and A. E. Fritzsche (EG & G, Inc., Las Vegas, Nev.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 2193-2216. 11 refs.

Features and efficiency of the advanced aerial radiation detection and tracking system, referred to as the Aerial Radiological Measuring System (ARMS), which is an integral part of the U.S. Atomic Energy Commission's environmental surveillance program, are described. The very diversified applications of this system are reviewed. Particular attention is given to the use of this system to determine the water equivalent of snow cover by measuring the natural terrain radiation attenuation through the snow. O.H.

A72-11886 # Automated delineation of wetlands in photographic remote sensing. W. G. Egan (Grumman Aerospace Corp., Bethpage, N.Y.) and M. E. Hair (Adelphi Institute of Marine Sciences, Oakdale, N.Y.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 2231-2251. 10 refs. Research supported by the Grumman Aerospace Corp. and the Adelphi Institute of Marine Sciences.

Description of an operational system for precision automated photometric mapping of wetlands achieved as the result of a program including aerial color film (both true color and false color infrared) calibration and control. The recognition appears to be most accurately achieved by microdensitometric analysis of the true color transparency in a narrow band centered in the red (0.633 micron), on 3000-ft altitude imagery. A computer generated map is obtained. (Author)

A72-17591 Radar as a possible instrument for snow depth measurements. J. A. Koehler and A. Kavadas (Saskatchewan, University, Saskatoon, Saskatchewan, Canada). (Canadian Aeronautics and Space Institute, Aerospace Electronics Symposium, Toronto, Canada, Mar. 15, 16, 1971.) *Canadian Aeronautics and Space Journal*, vol. 17, Dec. 1971, p. M-34, M-35. 8 refs.

Discussion of the possibilities of using radar methods in the determination of the properties of snow, such as density, water content, layer depth, and inhomogeneities. The available knowledge of the electrical properties of various snow cover types as reflectors for radio waves is shown to be far from complete. Besides, snow on the ground is a complex target in that, with the exception of a few types of terrain like dry sand areas, the ground frequently has a much higher reflectivity than the snow. Thus, the nature of the radar echo is determined by both the properties of the snow cover and that

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of the ground underneath. Echoes produced by such targets are difficult to interpret and at times convey information which cannot be processed without prior knowledge of the snow and ground properties. Some of the radar characteristics are discussed that the effectiveness of the snow-probing system requires. M.V.E.

A72-22315 Hydrologic data collection via geostationary satellite. A. F. Flanders and J. W. Schiest (NOAA, National Weather Service, Silver Spring, Md.). (*Institute of Electrical and Electronics Engineers, Annual International Geoscience Electronics Symposium, 3rd, Washington, D.C., Aug. 25-27, 1971.*) *IEEE Transactions on Geoscience Electronics*, vol. GE-10, Jan. 1971, p. 47-51.

The river and flood forecast and warning service of the National Weather Service depends on meteorological data and a vast hydrologic reporting network of nearly 5000 river and rainfall stations. Reports are collected daily or on a criteria basis during periods of heavy rainfall and/or high flow in the rivers. During the time from 1967 to 1969, an experiment in river and rainfall data collection via NASA's ATS-1 satellite was conducted. The technical and operational feasibility of data collection from remote sites via satellite was proved in the test. G.R.

A72-23295 # The determination of snow-lines from weather satellite pictures. K. Itten (Zürich, Universität, Zurich, Switzerland). In: *Internationale Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 1.* Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 455-464. 8 refs.

Description of a method determining temporary snow lines and their fluctuations, and the distribution of the snow-covered area. The study was undertaken in the Swiss Alps because of an existing dense network of weather stations. The results could thus be compared easily with the ground data. Surfaces enclosed by contour lines spaced at an interval of 500 m were constructed for the entire Alps with transparent material on the scale 1:4,000,000. The position of the temporary snow lines can be calculated with an accuracy within 250 m. The pictures were received from the ESSA-APT weather satellite. F.R.L.

A72-23302 # The determination of ice and snow from satellite photos (Erfassung von Eis und Schnee aus Satellitenphotos). H. Kaminski (Institut für Weltraumforschung, Bochum, West Germany). In: *Internationale Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 2.* Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 645-656. 6 refs. In German.

The importance of a determination of the aggregations of ice and snow on earth for climatological considerations is discussed. Such a determination can be suitably made with the aid of satellite pictures. It is proposed to set up six stations at certain points throughout the Northern and Southern hemispheres. In this way a worldwide determination of the sizes of ice and snow fields would be possible. G.R.

A72-28858 # Detailed short range prediction of hydro-meteors. R. E. Nagle (NOAA, National Environmental Satellite Service, Hillcrest Heights, Md.). In: *International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints.* Boston, American Meteorological Society, 1972, p. 311-316. 8 refs.

Method of combining the high-resolution observing capability of satellite cloud observation with the scales of motion capable of accurate prediction by operational numerical models. The program produces short-range (up to 36 hr) predictions of cloud patterns by a quasi-Lagrangian advection of digitized cloud brightness observations. In the case of the Earth Resources Technology Satellite (ERTS) system it is anticipated that the cloud advection model will provide the primary guidance for the programming of the daily data collections. F.R.L.

A72-31244 # Application of infrared techniques to the study of snow covers (Applicazioni delle tecniche all'infrarosso per lo studio dei manti nevosi). F. M. Vivona (CNR, Istituto di Fisica dell'Atmosfera, Rome, Italy). In: *Space activity in the field of ecology and earth resources; International Convention on Space, 12th, Rome, Italy, March 23-25, 1972, Proceedings.* Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1972, p. 289, 291-299. 12 refs. In Italian.

Discussion of radiometric techniques for the determination of the surface temperature of snow covers and glaciers and the air-snow energy balance. The instrument used, an airplane-or helicopter-borne infrared radiometer, is described. The results of meteorological parameter measurements are tabulated, and the diurnal variation of snow temperature at various levels is plotted. Other possible applications of infrared techniques are pointed out. B.B.M.

A72-33999 # Detection of thawing snow and ice packs through the combined use of visible and near-infrared measurements from earth satellites. A. E. Strong, E. P. McClain, and D. F. McGinnis (NOAA, National Environmental Satellite Service, Washington, D.C.). *Monthly Weather Review*, vol. 99, Nov. 1971, p. 828-830. 9 refs.

A case is made for the detection of melting snow or ice using multispectral remote sensing from earth satellites. Snow and thick ice are highly reflective in both the visible and the near-infrared portions of the electromagnetic spectrum. During thaw conditions, however, near-infrared radiation is absorbed strongly, while reflection of visible radiation is only slightly affected. Simultaneous visible and near-infrared imagery from the Nimbus 3 satellite illustrates how these reflectance differences can be used to obtain information of hydrologic usefulness. Two examples of such use are presented. (Author)

A72-43197 Outfall inventory using airphoto interpretation. K. R. Piech and J. E. Walker (Cornell Aeronautical Laboratory, Inc., Buffalo, N.Y.). *Photogrammetric Engineering*, vol. 38, Sept. 1972, p. 907-914. 26 refs. Army-sponsored research.

A test program to determine the effectiveness of conventional stereo color airphoto interpretation for outfall detection is described. The waterways studied were sections of the Cuyahoga and Ashtabula rivers (Ohio). It was found that color imagery provided sufficient information in almost all instances, with relatively little additional information provided by color-infrared imagery. The dominant detection/mechanisms were gross discoloration, identification of discharge structures, and evaluation of drainage patterns and complexes displaced from the shoreline. Typical photographs are analyzed. F.R.L.

A72-45215 # Developments in applications of remote sensing to hydrology. A. Adelman, R. Ambaruch, and J. W. Simmons (IBM Electronics Systems Center, Huntsville, Ala.). *International Astronautical Federation, International Astronautical Congress, 23rd, Vienna, Austria, Oct. 8-15, 1972, Paper.* 56 p. 17 refs.

Review of the progress and initial results of the first major part of a streamflow forecasting project applying remote sensing from aircraft and spacecraft to hydrology. The initial study phase, aimed at assessing the feasibility of applying remote sensed data to prediction of watershed performance, is approximately 30% complete. Methods for determining model parameters from physical characteristics, observable or inferable from remotely acquired photographs, without the necessity of historical streamflow data, are discussed. Special difficulties encountered in inferring model parameters are emphasized. M.V.E.

A73-10191 Backscatter from snow and ice surfaces at near incident angles. P. Hoekstra (U.S. Army, Cold Regions Research and Engineering Laboratory, Hanover, N.H.) and D. Spanogle (USAF, Holloman AFB, N. Mex.; General Dynamics Corp., Convair Aerospace Div., Fort Worth, Tex.). *IEEE Transactions on Antennas and Propagation*, vol. AP-20, Nov. 1972, p. 788-790. ARPA-supported research. ARPA Order 1615.

The radar backscatter of natural snow surfaces was measured at 10 and 35 GHz and at grazing angles from 1 to 0.3 deg. For horizontal polarized radiation the terrain clutter per unit area (sq m) at 10 GHz of a flat snow terrain decreases from -50 dB at 1 deg to -70 dB at 0.4 deg. The return is approximately 10 dB lower for vertical polarized radiation. The terrain clutter was found to depend on the free water content of the snow. The radar cross sections of ice blocks placed on the snow surface are roughly proportional to the square of the area of the ice block facing the radar at 10 and 35 GHz and are approximately 20 dBsm below the return expected for a perfectly reflecting plane surface. At 95 GHz the ice blocks become diffuse reflectors. (Author)

A73-15774 Satellite data and estimates of precipitation for hydrologic applications. P. A. Davis and S. M. Serebreny (Stanford Research Institute, Menlo Park, Calif.). In: Remote sensing of earth resources and the environment; Proceedings of the Seminar in-Depth, Palo Alto, Calif., November 8, 9, 1971. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1972, p. 57-61.

Description of initial research efforts aimed at developing a simple technique for estimating total precipitation (rain and snow) over a specific drainage basin (Flathead River in northwestern Montana) on the basis of existing series of satellite cloud photographs. Time periods covered were fall and early winter of 1968 and spring and early summer of 1969. Surface measurements were compared estimates based on satellite observations for the purpose of identifying significant correlations. Results are discussed in terms of the importance of the organization and movement of cloud patterns in estimating precipitation. T.M.

A73-22388 * Interpretation of wetlands imagery based on spectral reflectance characteristics of selected plant species. V. P. Carter (U.S. Geological Survey, Washington, D.C.) and R. R. Anderson (American University, Washington, D.C.). In: American Society of Photogrammetry, Annual Meeting, 38th, Washington, D.C., March 12-17, 1972, Proceedings. Falls Church, Va., American Society of Photogrammetry, 1972, p. 580-595. 6 refs. NASA:supported research.

A73-29237 Wetlands mapping in New Jersey. R. R. Anderson (American University, Washington, D.C.) and F. J. Wobber (Earth Satellite Corp., Washington, D.C.). (*American Society of Photogrammetry and American Congress of Surveying and Mapping, Annual Convention, Washington, D.C., Mar. 12-17, 1972.*) *Photogrammetric Engineering*, vol. 39, Apr. 1973, p. 353-358.

The New Jersey Wetlands Act of 1970 required that mapping and inventory of wetlands along the marine coastal zone and tide-influenced estuaries of the state be undertaken in order that this important natural resource be properly managed. A prime requirement was that map products have validity which could withstand the challenge of litigation. Natural-color and color-infrared aerial photographs at a scale of 1:12,000 were obtained over two sites designated by the state. Final map products were prepared containing (1) the upper wetlands boundary; (2) the line of biological mean high water to establish state riparian lands; and (3) delineation of major plant species associations of five acres or larger in size. (Author)

A73-33359 Airborne remote sensing of Georgia tidal marshes. D. E. Thompson (MAPCO, Inc., Daytona Beach, Fla.). In: Operational remote sensing; Proceedings of the Seminar, Houston, Tex., February 1-4, 1972. Falls Church, Va., American Society of Photogrammetry, 1972, p. 128-140.

Scientists consider the marshes as a primary food production center for the estuaries and continental shelf marine ecosystem. Airborne remote sensing of estuarine marshes, coupled with reliable ground truth data, provides the only feasible, economic means of assessing actual primary production. Work performed to date represents primary production measurements on a scale never before attempted. Integration of ground truth with photographic and nonphotographic images represents a first in tidal marsh ecology. F.R.L.

A73-34942 # Infrared sensing of the surface temperature of certain lakes of Northern Italy (Rilevi all'infrarosso della temperatura superficiale di alcuni laghi dell'Italia Settentrionale). M. Giorgi, M. Colacino, F. M. Vivona (CNR, Istituto di Fisica dell'Atmosfera, Rome, Italy). In: The control of the terrestrial environment from space: International collaboration, methods and technologies; International Conference on Space, 13th, Rome, Italy, March 22-24, 1973, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1973, p. 225, 227-236. 13 refs. In Italian.

A73-34944 # Airborne and satellite remote sensing of Anacapa Island for hydrology and aquatic biology. D. T. Hodder (North American Rockwell Corp., Downey, Calif.) and M. C. Kolipinski (U.S. Park Service, San Francisco, Calif.). In: The control of the terrestrial environment from space: International collaboration, methods and technologies; International Conference on Space, 13th, Rome, Italy, March 22-24, 1973, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1973, p. 255, 257-264. Contract No. N00014-70-C-370.

Anacapa Island is about twelve miles off the southern California coast. It is divided into arid and semihumid maritime Mediterranean climates. A satellite image is considered from the standpoint of providing a synoptic view of currents in the channel, the sources of sediment from fluvial discharges and longshore drift and finally the transport of mainland sediment offshore. Based upon the analysis of this experiment, simultaneous remote sensing is not only desirable but necessary to meet the resource inventory and mapping experiment goals set for the Channel Islands. G.R.

A73-35664 * Remote sensing of chlorophyll and temperature in marine and fresh waters. J. C. Arvesen, J. P. Millard (NASA, Ames Research Center, Moffett Field, Calif.), and E. C. Weaver (San Jose State College, San Jose, Calif.). *Astronautica Acta*, vol. 18, June 1973, p. 229-239. 20 refs.

An airborne differential radiometer was demonstrated to be a sensitive, real-time detector of surface chlorophyll content in water bodies. The instrument continuously measures the difference in radiance between two wavelength bands, one centered near the maximum of the blue chlorophyll a absorption region and the other at a reference wavelength outside this region. Flights were made over fresh water lakes, marine waters, and an estuary, and the results were compared with 'ground truth' measurements of chlorophyll concentration. A correlation between output signal of the differential radiometer and the chlorophyll concentration was obtained. Examples of flight data are illustrated. Simultaneous airborne measurements of chlorophyll content and water temperature revealed that variations in chlorophyll are often associated with changes in temperature. Thus, simultaneous sensing of chlorophyll and temperature provides useful information for studies of marine food production, water pollution, and physical processes such as upwelling. (Author)

A73-35914 # Satellite climatology (Sputnikovskaja klimatologija). K. Ia. Kondrat'ev (Leningradskii Gosudarstvennyi Universitet; Glavnaia Geofizicheskaja Observatoriia, Leningrad, USSR). In: All-Union Meteorological Conference, 5th, Leningrad, USSR, June 21-25, 1971, Transactions. Volume 3. Leningrad, Gidrometeoizdat, 1972, p. 107-123. 92 refs. In Russian.

Papers concerning climatological studies based on satellite meteorological data are surveyed. Studies of cloud, snow and ice covers, of wind and precipitations, of the temperature fields of underlying systems, and of the thermal balance of the earth are covered. V.Z.

A73-38021 # Mapping of snow cover in the Swiss Alps from ERTS-1 imagery. H. Haefner, R. Gfeller (Zürich, Universität, Zürich, Switzerland), and K. Seidel (Eidgenössische Technische Hochschule, Zürich, Switzerland). *COSPAR, Plenary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper. 8 p.*

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A semiautomated mapping system was developed by combining the possibilities of a Quantimet 720 for the individual discrimination of the critical density level in each image with the advantage of high-resolution photographic techniques for the execution of the density slicing. The visually determined density level on the monitor is used as reference time to expose a lith-film. The snow cover is transferred onto a special 1:500,000 topographical map, but for this procedure SCC-imagery is necessary. Investigations were undertaken on the accuracy of the areal measurements in the different MSS-bands. The results show that image series with the old and melting snow cover differ greatly in the reproduced areas, while image series taken shortly after a new snowfall produce more or less the same results. This opens a possibility for a further characterization of the surface of the snow cover by using all four bands in combination. (Author)

A73-36022 # Applications of ERTS Imagery to snow and glacier hydrology. M. F. Meier (U.S. Geological Survey, Tacoma, Wash.). *COSPAR, Plenary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper.* 13 p. 9 refs.

The percentage of snow-cover area on specific drainage basins was measured from ERTS imagery by video density slicing with a repeatability of 4% of the snow-covered area. Data from ERTS images of the melt season snow-cover in the Thunder Creek drainage basin in the North Cascades were combined with existing hydrologic and meteorologic observations to enable calculation of the time distribution of the water stored in this mountain snow pack. Similar data could be used for frequent updating of expected inflow to reservoirs. Equivalent snow-line altitudes were determined from area measurements. Snow-line altitudes were also determined by combining enlarged ERTS images with maps with an accuracy of about 60 m under favorable conditions. (Author)

A73-36025 # New ways to monitor the mass and areal extent of snowcover. M. F. Meier (U.S. Geological Survey, Tacoma, Wash.). *COSPAR, Plenary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper.* 11 p. 28 refs.

Synoptic data on the snow pack is of great importance to hydrology. Continuous monitoring of the highly variable snow cover, which covers a quarter of the earth's land surface more than four months of the year, is possible only from satellites. Snow can be readily distinguished from bare land on meteorological satellite images, but can be distinguished from clouds only with difficulty. Higher resolution images such as those from ERTS-1 allow improved recognition of snow. Data on snow-covered areas and snow water equivalent are both needed by hydrologists, and these data can best be acquired by microwave or radio wavelength sensors. Passive microwave emission techniques appear to offer the potential of continuous monitoring of snow-covered areas, snow wetness, and possibly snow water equivalent. F.R.L.

A73-36026 # Applications of the ERTS-1 satellite in remote sensing of water resource data in Canada. J. D. Mollard (J. D. Mollard and Associates, Ltd., Regina, Saskatchewan, Canada) and P. A. Carr (Department of Environment, Inland Water Directorate, Ottawa, Canada). *COSPAR, Plenary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper.* 53 p. 20 refs.

In Canada the ERTS-1 satellite is being used to help solve hydrologic problems in two principal ways. First, the space imagery is being interpreted to facilitate surveys that explore, measure, develop, and conserve Canada's surface and underground waters. Secondly, the ERTS-1 satellite is being used to retransmit data on water levels, ice break-up, and chemical quality obtained from platforms installed in remote Canadian lakes and rivers. Applications discussed include rapid and inexpensive preparation of schematic terrain and hydrogeological maps of northern Canada, mapping surface-water bodies and certain data on the quality of water in them, detecting underground water supplies and identifying ground-water recharge and discharge areas, detecting faintly expressed manifestations of geological structures and discontinuities that

control ground-water flow and localize mineral and petroleum deposits, and mapping sedimentation in rivers and lakes that present construction, fish, and wildlife environmental problems. (Author)

A73-36027 # Teledetection of hydrological phenomena (Télé-détection de phénomènes hydrologiques). Y. Vuillaume (Service Géologique National, Département Géologie de l'Aménagement, Orléans, France). *COSPAR, Plenary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper.* 25 p. 23 refs. In French.

In the teledetection of hydrological phenomena, the principal results acquired show the advantages of passive detectors in the visible (reflectance) and the infrared (reflectance, emissivity) as a means of detection of hydrological phenomena. The objective can be obtained by a multispectral analysis of phenomena in the 'specific' frequencies previously selected in the course of systematic experiments carried out on the ground, then in the air; by a displacement of picked-up frequencies toward the hyperfrequencies, which permits access to data influenced by a hydrological factor; and to define the optical mission parameters for the themes of application considered, and thus to dimension the spatial systems and evaluate their compatibility or competitiveness with conventional methods. F.R.L.

A73-36840 Use of continuous simulation models in application of remote sensing to hydrology. R. Ambaruch and J. W. Simmons (IBM Electronic Systems Center, Huntsville, Ala.). In: *Summer Computer Simulation Conference, Montreal, Canada, July 17-19, 1973, Proceedings. Volume 2.* La Jolla, Calif., Society for Computer Simulation, Inc., 1973, p. 650-668. 8 refs.

Summary of the progress so far achieved in the selection of calibration and simulation models useable in applications of remote sensing to hydrology. The construction of the data base, an analysis of the sensitivity of the simulation model to variation in its parameters, methods used to derive model parameter values from aerial photographs, and some of the results obtained from operating the models are discussed. M.V.E.

A73-38074 Water resources systems modelling today and its research opportunities. W. S. Butcher (Texas, University, Austin, Tex.). In: *Joint Automatic Control Conference, 14th, Columbus, Ohio, June 20-22, 1973, Preprints of Technical Papers.*

New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 812-814. 11 refs.

The present status of the field of water resources is surveyed with respect to its objectives and problems, management and planning, as well as operation and maintenance routines. Some of the changes in this field in the ten years of its existence are shown to include: (1) the development of satisfactory stream flow synthesis techniques; (2) the refinement of rainfall-runoff models, and (3) the thorough exploration of the use of formal optimization methods in solving water problems. M.V.E.

A73-39840 # Satellite detection of melting snow and ice by simultaneous visible and near-IR measurements. D. F. McGinnis (NOAA, National Environmental Satellite Service, Hillcrest Heights, Md.). In: *International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-8, 1972, Proceedings. Volume 1.* Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 231-240. 10 refs.

A73-39841 # Locating large masses of ground ice with an impulse radar system. C. L. Bertram, K. J. Campbell, and S. S. Sandler (Geophysical Survey Systems, Inc., Billerica, Mass.). In: *International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-8, 1972, Proceedings. Volume 1.* Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 241-260. Contract No. N00014-71-C-0392.

A73-39842 # High resolution measurements of snowpack stratigraphy using a short pulse radar. R. S. Vickers and G. C. Rose (Colorado State University, Fort Collins, Colo.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1.

Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 261-277. 8 refs. U.S. Bureau of Reclamation Contract No. 14-16-D-7159.

A73-39884 # Multispectral remote sensing of elements of water and radiation balances. W. A. Malila and T. W. Wagner (Michigan Environmental Research Institute, Ann Arbor, Mich.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 639-663. 33 refs.

Methods for extracting a diversity of useful information from multispectral scanner data are illustrated for evaluating elements of the terrestrial water balance equation. Radiation balance and water balance relationships are linked by the energy budget equation, and scene attributes are derived from scanner signals for detailed scene radiation mapping. The synoptic coverage and quantitative extrapolation capabilities of multispectral systems are discussed. (Author)

A73-39812 * # ERTS-1 study of reservoirs in Kansas. H. L. Yarger, G. W. James, L. M. Magnuson (Kansas University, Lawrence, Kan.), J. C. Colner, J. R. McCauley (Center for Research, Inc., Lawrence, Kan.), and G. R. Marzolf (Kansas State University of Agriculture and Applied Science, Manhattan, Kan.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2.

Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 1477-1490. Contract No. NASB-21822.

Single pass coverage over Cedar Bluff, Webster, Tuttle Creek, Milford, and Council Groves reservoirs is analyzed. The long-range goal of the study is to test the feasibility of monitoring reservoirs by satellite. It is hoped that results may eventually help to optimize reservoir management for use in flood control, agriculture, urban areas, and recreation. ERTS-1 imagery promises to be a very useful tool for studying reservoir turbidity patterns. Initial coverage indicates a strong qualitative correlation between film density and turbidity. F.R.L.

A73-39914 # Expected results of hydrologic and geologic studies using ERTS imagery of the Atacama Desert, Altiplano, and Puna de Atacama, South America /Southwest Bolivia, Northwest Argentina, and Northern Chile/. G. E. Stoertz and G. E. Erickson (U.S. Geological Survey, Washington, D.C.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2.

Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 1523-1540. 19 refs.

A73-40832 # Assessment of applications of space-borne remote sensing to hydrology and water resources - An overview. P. Bock (Connecticut, University, Storrs, Conn.). COSPAR, Plenary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper. 45 p. 30 refs.

The three main subjects discussed are hydrology and water resources, the present status of remote sensing in hydrology and water resources, and the potential future role of remote sensing. Recent studies have indicated that irrigation may become the key issue of water resources development in the long-range perspective. Also important are the rural-urban water supply and industrial water supply. Results from NASA's Earth Resources Technology Satellite-1 (ERTS-1) studies both outside and inside the U.S. are given. It is pointed out that space technology comes at a time when scientific knowledge of the hydrologic cycle and management knowledge of water projects are becoming vital to rational planning. F.R.L.

A73-42730 * Remote measurement of salinity in an estuarine environment. G. C. Thomann (NASA, Johnson Space Center, Earth Resources Laboratory, Bay St. Louis, Miss.). *Remote Sensing of Environment*, vol. 2, no. 4, 1973, p. 249-259. 21 refs.

The microwave emission of sea water is dependent upon salinity in the low microwave spectrum, and it appears possible to measure remotely surface salinity at 21-cm wavelength with an accuracy up to one part salt per thousand parts water (.1%) for a .5 to 3.5% salinity range. The dielectric constant of sea water can be represented by that of NaCl, except that the sea water conductivity is retained. The effects of the atmosphere, cosmic noise, sea surface roughness, and constant radiometer errors can be corrected by using surface calibration measurements. In experiments performed in Mississippi and Louisiana coastal waters salinity accuracies of .3 to .5 were obtained. It is believed that the accuracy was limited by the radiometer used. (Author)

A73-42823 Remote sensing of estuarine circulation dynamics. R. L. Mairs (NOAA, National Environmental Satellite Service, Hillcrest Heights, Md.) and D. K. Clark (U.S. Naval Oceanographic Office, Washington, D.C.). *Photogrammetric Engineering*, vol. 39, Sept. 1973, p. 927-938.

Multispectral and color aerial photography and infrared imagery of naturally occurring water color boundaries and/or dye tracer implants have been used successfully in the study of temporal coastal and estuarine circulation dynamics. Sequential photography and high-contrast enhancements of color imagery of fronts such as foam lines, current shears, etc., along with point and line sources of fluorescein dye are used to calculate and plot displacements and velocity vectors of water masses along the North Carolina coast and in the Patuxent River estuary, Maryland. Techniques have been developed for incorporation of remotely sensed data which are collected on a temporal scale ranging from minutes to hours, with extensive surface truth measurements to describe further the complex nature of estuarine flow. (Author)

N70-17728 World Meteorological Organization, Geneva (Switzerland).

PROCEEDINGS OF THE SYMPOSIUM ON HYDROLOGICAL FORECASTING

1969 332 p refs. Conf. held at Surfer's Paradise, Australia, 29 Nov.-25 Dec. 1967; Sponsored jointly by WMO and UNESCO /ts Tech. Note No. 32

(WMO-228-TP-122) Copyright. Avail: WMO, Geneva

Conference papers of the symposium on hydrological forecasting are presented.

N70-17733 Bureau of Meteorology, Melbourne (Australia). SOME POTENTIAL APPLICATIONS OF METEOROLOGICAL SATELLITES IN FLOOD FORECASTING

A. F. Rainbird. In WMO Proc. of Symp. on Hydrol. Forecasting 1969 p 73-80 refs

Copyright. Avail: WMO, Geneva

The possibility of using satellite observations for the formulation of flood forecasts for a river basin and problems encountered are discussed and a cloud-height/rainfall analysis of Southeast Africa from data collected by TIROS satellites is presented. Although at the present time the observation of hydrometeorological parameters by satellite-mounted sensors is still rather coarse, the observing capabilities of satellite sensor-systems are improving rapidly and the possibility of using satellite-gathered infrared radiation data appears feasible in the near future. ESRO

N70-17751 India. Meteorological Dept., New Delhi. Instrument Div.

AUTOMATIC INSTRUMENTATION FOR TELEMETERING RAIN AND RIVER-LEVEL DATA FROM REMOTE STATIONS

06 HYDROLOGY AND WATER MANAGEMENT

S. V. Datar and P. Mohammed *In WMO Proc. of Symp. on Hydrol. Forecasting 1969* p 300-308
Copyright. Avail: WMO, Geneva

A tipping-bucket raingage which measures rainfall collected in a receiving funnel and gives electrical pulses equal in number to the millimeters of rain is described. An unmanned radio-reporting raingage station, consisting of a rainfall receiver, a rainfall recording unit, a programming and coding unit, a transmitter, and a power supply unit are also described. **ESRO**

N70-18469# Army Foreign Science and Technology Center, Washington, D.C.

DECODING AERIAL PHOTOGRAPHS OF GLACIAL LANDSCAPES: INDICATORS OF GROUND WATERS

G. Ya. Meer et al 7 Oct. 1969 33 p refs Transl. into ENGLISH from Akad. Nauk SSSR. Lab. Aerometodov Primeneniye Aerometodov Dlia Izuch. Gruntovykh Vod (USSR), 1962 p 69-79 (AD-696181; FSTC-HT-23-398-68) Avail: CFSTI CSCL 8/8

Characteristics of landscape indicators of ground waters are described for the following: four glacial types of landscape, including hilly-moraine, drumlin, morainic plain and terminal-moraine; three water-glacial types of landscape, including kame (and os), lake-glacial plain and outwash plain; the karst erosion type of landscape; and seashores. The decoding of these types of terrain on aerial photographs is discussed. **Author (TAB)**

N70-20057 Texas A&M Univ., College Station.

THE MISSISSIPPI RIVER OUTFLOW, ITS SEASONAL VARIATIONS AND ITS SURFACE CHARACTERISTICS

Don Walsh (Ph.D. Thesis) 1968 238 p
Avail: Univ. Microfilms: HC \$10.80/Microfilm \$3.10 Order No. 69-8515

This investigation provides a tentative description of mean seasonal and monthly outflow patterns together with an analysis of the factors that shape them. Pertinent historical and contemporary data are limited and this effort is only a first approximation of actual conditions. It is shown that averaging of several years' data can provide acceptable mean values of the pertinent properties such as river outflow, wind field, and sea surface temperatures. River discharge is the dominant influence for variation of the outflow pattern and its surface characteristics. Therefore the dynamics of river flow were investigated as a three-step system: flow in a salt wedge estuary, jet discharge at the river mouth, and jet modified by offshore processes. Reasonable relationships were found for the first two steps, however, a mathematical treatment for the third appears intractable at this time. Empirical data was used to describe this step. The mean patterns showed cold river water veering towards the west under influence of prevailing winds and currents. **Dissert. Abstr.**

N70-22306# Wyoming Univ., Laramie. Water Resources Research Inst.

SNOW RANGE WATER RESOURCE OBSERVATORY Progress Report

Paul A. Recharad Sep. 1969 57 p refs /ts Water Resources Ser. No. 15 (PB-187840) Avail: CFSTI CSCL 13B

The instrumentation within the Snowy Range Water Resource Observatory is described. Some of the problems of operating and maintaining the instruments are discussed. Methods of portraying the data collected are presented and the ADP card format and computer program for processing hygrothermograph records is given. **Author (USGRDR)**

N70-26632# Florida Atlantic Univ., Boca Raton. Dept. of Geography.
REVIEW OF NEW GEOGRAPHIC METHODS AND TECHNIQUES. QUESTIONNAIRE SURVEY. WATER

RESOURCES PLANNING AND MANAGEMENT. RECENT TRENDS IN REMOTE SENSING TECHNOLOGY, APPENDIX

C Final Technical Report

Robert J. Tata, Cecil E. Palmer, and Richard E. Witmer Oct. 1969 97 p refs
(Contract DAAK02-68-C-0219)
(AD-700176) Avail: CFSTI CSCL 8/8

In doing work for a research project on new geographic methods and techniques, the three reports and bibliographies included in this study were developed. Because the reports are of interest, but not directly related, to the central goal of the methodological treatise, they are presented for researchers concerned. The first report summarizes the results of a questionnaire survey of geographers who are active in researching methodological topics; the second report deals with the geographers role in studies of water resource planning and management; and the final study comprises report and bibliography on new systems of remote sensing techniques. **Author (TAB)**

N70-26269# Hawaii Univ., Honolulu. Water Resources Research Center.

A HYDROGEOPHYSICAL SURVEY FROM KAWAIHAE TO KAILUA-KONA, HAWAII

William M. Adams, Frank L. Peterson, Surendra P. Mathur, Larry K. Lepley, Clifton Warren et al Sep. 1969 151 p refs
Sponsored by the Dept. of Interior and in part by Hawaii State Dept. of Land and Nat. Resources Prepared in cooperation with Hawaii Inst. of Geophysics
(PB-187520; HIG-WRRC-4; W-70-00908; TR-32) Avail: CFSTI CSCL 08H

Several geophysical surveys were conducted over the coastline area between Kawaihae and Kailua-Kona for the purpose of locating the optimum sites for possible development of ground water from the basal lens. A low level aeromagnetic survey over the area and an infrared scanning effort along the coast with surface verification provided general reconnaissance information. Audiomagnetotelluric and dc electrical resistivity profiles defined more detailed, local structures. The infrared scanning survey along the coastline did not reveal any thermal anomalies that are reasonably attributable to previously unknown outflows of brackish water. The aeromagnetic and audiomagnetotelluric surveys locate four lines which are possible barriers to lateral movement of basal ground water. Based on the resistivity data, three possible sites for test drilling are selected. **Author (USGRDR)**

N70-28678# National Environmental Satellite Center, Washington, D.C.

STUDY OF THE USE OF AERIAL AND SATELLITE PHOTOGRAMMETRY FOR SURVEYS IN HYDROLOGY

Everett H. Ramey Mar. 1970 28 p refs
(ESSA-TM-NESCTM-14) Avail: CFSTI

Possible applications of photogrammetry in problems of hydrology are discussed. The critical factors in the use of satellite photographs are included. The various physical and economic factors in the use of aerial photogrammetry are analyzed in the measurement of both snow cover and snow depth. It was concluded that the required accuracy can be attained, but sometimes the cost would be prohibitive. The use of aerial photography and other related sensors to some other problems in hydrology are considered. Remote sensing from aircraft offers the hydrologist a feasible means to map some special events where detailed mapping is needed. **Author**

N70-32264# Long Island Univ., Greenvale, N.Y. Science Engineering Research Group.
REMOTE SENSING OF COASTAL WATERS USING MULTISPECTRAL PHOTOGRAPHIC TECHNIQUES Final Technical Report

Edward Yost and Sondra Wenderoth 1 Jan. 1970 219 p refs
(Contract N00014-67-C-0281)
(AD-705116; SERG-TR-10) Avail: CFSTI CSCL 14/5

An evaluation of multispectral photographic techniques for optical penetration of water in Northeastern United States and Gulf of Mexico coastal waters showed the green spectral band to maximize the detectability of underwater targets. This type of particulate matter in suspension in the water as well as the size and quantity of the particles significantly affects the ability to optically penetrate water. In general, the spectral band (493-543nm) when exposed to place the water mass at about unity density on the photographic emulsion, was found to give the best water penetration independent of altitude or time of day as long as solar glitter from the surface of the water was avoided. When optimally exposed, the images of surface and underwater objects showed greater chromatic enhancement in multispectral color renditions than on conventional Aerial Ektachrome color films. Multispectral negative color renditions were found to be equally as good as positive color images for achieving color differences between the water mass and submerged objects. An isoluminous color technique has been perfected. This photographic process eliminates the dimension of brightness from a multispectral color presentation. By this method, objects exhibiting subtle spectral differences which are normally obscured by the comparatively large brightness present in coastal waters can be detected. Author (TAB)

N70-38843* Geological Survey, Washington, D.C.
**HYDROLOGIC INTERPRETATION OF NIMBUS VIDICON
IMAGE: GREAT SALT LAKE, UTAH**

D. C. Hahl and A. H. Handy Nov. 1966 6 p /ts Tech. Letter
NASA-61

(NASA Order R-09-020-015)

(NASA-CR-79887) Avail: CFSTI CSCL 08E

The analysis was made to determine if features of hydrologic significance were visible and identifiable. The features that are pointed out on an annotated copy of the image indicate some of the factors that are required to produce an image. Vegetation and geology may be responsible for the delineation or lack of delineation of some features. Depth is not considered a factor in producing an image. The implications of using the Advanced Vidicon Camera System in the field of hydrology are assessed. H.S.W.

N70-38529* National Environmental Satellite Center, Washington, D.C.

**REPORTS, STUDIES, AND INVESTIGATIONS RELATING
TO SATELLITE HYDROLOGY: ANNOTATED BIBLIOGRAPHY**

D. R. Baker, A. F. Flanders, and M. Fleming Jun. 1970 30 p
refs

(ESSA-TM-NESCTM-10) Avail: CFSTI

Presented is an annotated bibliography for a satellite hydrology program. The objective of this program is to develop hydrologic problems from satellite investigations, reports, and studies. G.G.

N70-38929* Geological Survey, Washington, D.C.
**HYDROLOGIC EVALUATION OF GEMINI PHOTOGRAPHS
OF FRINGES OF THE SAHARA, AFRICA**

J. R. Jones Apr. 1967 16 p /ts Tech. Letter NASA-68

(NASA Order R-09-020-013)

(NASA-CR-84588) Avail: CFSTI CSCL 08H

Five Gemini color photographs, including one from Gemini 4, three from Gemini 5, and one from Gemini 9, are evaluated for their content of information of hydrologic significance. Geographic, geomorphic, and geologic features are annotated on overlays. Outstanding features clearly displayed in the photos include the paleohydrologic (transitional) nature of the eastern shore of Lake Chad; topographic and color manifestations of geology near the Atlantic Coast of Morocco, and the hydrologic control on location of

towns in that region (37 towns were located in one photograph); the sharp contrast between the water-rich Nile Delta and adjacent desert; the disappearance of the Jabal Nafusah escarpment in Libya; and the intricate drainage patterns of the flat-lying beds which form the Jabal Nafusah. Author

N70-40772* Virginia Inst. of Marine Science, Gloucester Point.
**PRIORITY PROBLEMS AND DATA NEEDS IN COASTAL
ZONE OCEANOGRAPHY. EARTH OBSERVATION
SATELLITE PLANNING**

John C. Mundy, Jr., Edwin B. Joseph, Robert J. Byrne, John L. Dupuy, Thomas D. Wright et al Sep. 1970 138 p refs
(Contract NAS1-9461)

(NASA-CR-111779) Avail: NTIS CSCL 08I

Coastal zone oceanographic problems and data needs have been defined for an oceanographic satellite. Problems are based on national and coastal zone priorities. Descriptions of the problems discuss the data needs and the expected utility of remote measurement. Data needs and resolution requirements are specified for surface and satellite measurement. Remote measurables are numerically ranked and evaluated. An experiment in coastal zone oceanography is proposed for ERTS A. Coordination of the ERTS program with IDOE is discussed. Author

N70-40812* Old Dominion Coll., Norfolk, Va.

**A SURVEY OF THE PROBLEMS AND RESEARCH NEEDS
IN THE COASTAL ZONE**

William J. Hanna, Harold G. Marshall, James F. Slowey, eds. 15
Sep. 1970 109 p refs

(Contract NAS1-9434)

(NASA-CR-111780) Avail: NTIS CSCL 08J

The major problems and research needs in coastal zone oceanography are presented for the individual disciplines of biology, chemistry, geology, and physics, including zone meteorology. Among coastal zone problems highest priority is assigned to pollution. The greatest need was found to be acquisition of more physical data for improving our knowledge of coastal water mixing processes. Required ground truth measurements and possible application of Earth Resources Satellite sensory data for solution of specific problems are given. Special emphasis is given to those problems and needs of an interdisciplinary nature. E.M.C.

N70-41149* Geological Survey, Washington, D.C.

**LAKE SURVEYING TECHNIQUES IN THE GEOLOGICAL
SURVEY Progress Report**

H. E. Skibitzke and C. J. Robinove Jun. 1966 22 p /ts Tech.
Letter NASA-21

(NASA Order R-09-020-009)

(NASA-CR-76006) Avail: NTIS CSCL 08F

An outline is presented on lake studies, conducted to determine ways in which data could be collected synoptically and in a repetitive manner and analyzed for water resource classification and management. Airborne color and infrared photography were used to assess diurnal variation in radiation over both land and water surfaces, map the mixing of pollutants at the water-surface boundary, identify water surface color and bottom features, map the stage of eutrophication of lakes and the color as an indication of biological and chemical character, aid in the description of potholes as sources or sinks of ground water and their usefulness as wildlife breeding grounds, delineate mixing patterns in water, and measure light penetration and turbidity. L.E.W.

N70-41150* Geological Survey, Washington, D.C.

**A PRELIMINARY EVALUATION OF AIRBORNE AND
SPACEBORNE REMOTE SENSING DATA FOR HYDROLOGIC
USES**

Charles J. Robinove Jul. 1966 19 p refs /ts Tech. Letter
NASA-50

06 HYDROLOGY AND WATER MANAGEMENT

(NASA Order R-09-020-009)

(NASA-CR-76594) Avail: NTIS CSCL08H

Remote sensors are examined as valuable tools for obtaining water-resource data on occurrence, movement, and interactions of water, and as a basis for control. Tabulated data present a brief evaluation of airborne and spaceborne remote sensors used in hydrology. Limited use of sensors is defined in the areas of measuring physical, chemical, and biological characteristics of water surfaces, mapping and describing ground-water features, snow surveying and mapping, glaciology, geomorphology, and measuring liquid-vapor transfer. S.P.

N70-42681*# Texas A&M Univ., College Station. Remote Sensing Center.

ON AIR TEMPERATURE FLUCTUATIONS IMMEDIATELY ABOVE A GLACIER SURFACE

Aylmer H. Thompson and Paul E. Carrara (Colo. Univ., Boulder) Apr. 1970 49 p refs

(Grant NGL-44-001-001)

(NASA-CR-110834; RSC-13) Avail: NTIS CSCL04B

Measurements of air temperature fluctuations above the surface of the Juneau icefield of southeastern Alaska are discussed. The observations are represented as a series of profiles of the value of each parameter as a function of time. The data are to be used in designing remote sensing techniques for measuring meteorological parameters in surface layers of cold regions, especially of snow-covered surfaces. R.B.

N71-11152*# Geological Survey, Raleigh, N.C.

APPLICATION OF INFRARED IMAGERY IN STUDYING THERMAL CHARACTERISTICS OF A COOLING RESERVOIR

J. F. Turner, Jr. In NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 3 1969 10 p

Avail: NTIS CSCL08F

Heat disposal at the cooling reservoir for a large steam-electric generating plant involves circulating large quantities of cooling water from the lake through the condensing coils of the generators and then back to the lake. Detailed information on lake surface temperature was obtained by infrared imagery during overflight with subsequent data processing and interpretation in developing a thermal map of the reservoir. Although only one set of infrared imagery was obtained during the study, it is concluded that low-altitude, predawn remote sensing flights made during clear weather, will provide information needed in mapping surface temperatures of cooling reservoirs. Even though the imagery was obtained during adverse weather conditions, portions of the imagery accurately described temperature variations in the reservoir and allowed the development of a thermal map. Author

N71-11153*# Geological Survey, Anchorage, Alaska. Water Resources Div.

HYDROLOGIC STUDIES IN NORTHERN COOK INLET, ALASKA USING COLOR PHOTOGRAPHY AND THERMAL IMAGERY

W. W. Barnwell and Chester Zenone In NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 3 1969 17 p refs

Avail: NTIS CSCL08H

Photography and thermal infrared imagery of the Northern Cook Inlet area in south-central Alaska were obtained. The color photographs provided sharp detail in landscape features, and thermal infrared imagery enabled delineation of swampy areas from well-drained areas. Color differences on the color infrared photographs correlated with warm and cold ground detected by the thermal infrared imagery. Both color and thermal patterns indicate

current directions in Cook Inlet, where cool silt-laden fresh water mixes with the salt water. Author

N71-11155*# Geological Survey, Washington, D.C. Water Resources Div.

SYNOPTIC REMOTE-SENSING SURVEY OF LAKES IN WEST-CENTRAL FLORIDA

Joseph W. Stewart In NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 3 1969 33 p refs

Avail: NTIS CSCL08H

Remote sensing from aircraft has useful application in lake studies of west-central Florida. Thermal infrared imagery and photography in the visible and near infrared range of the electromagnetic spectrum provide a detailed synoptic record over a large area during a near-instantaneous time interval. Both natural color and infrared color photography were obtained for this study. The color infrared photography was preferred: (1) in hydrologic studies based upon vegetative indicators; (2) in delineation of shoreline boundaries; and (3) in qualitative evaluations of depth and turbidity. However, color infrared photographs appear unnatural because health vegetation is a shade of red and turbid water tends to be a shade of pale green or pale blue. Natural color photographs provide an image similar to that sensed by the human eye and are a helpful addition for proper interpretation of phenomena represented on the color infrared photographs. Author

N71-11157*# American Univ., Washington, D.C. Dept. of Biology.

THE USE OF COLOR INFRARED PHOTOGRAPHY AND THERMAL IMAGERY IN MARSHLAND AND ESTUARINE STUDIES

Richard R. Anderson In NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 3 1969 30 p refs

Avail: NTIS CSCL08H

Presented are results obtained from data provided by two overflights. The following conclusions may be made: (1) color infrared photography was superior to natural color in marshland plant-community delineation, particularly with increase in altitude; (2) there is considerable tonal change in marsh vegetation during the growing season, reflecting a decline of some species and a succession of others; (3) color infrared photography is superior to natural color in detecting sources and distribution of sediment in estuarine water; (4) sunglint from water may be avoided without undue degradation of the tone quality of the marshland vegetation; (5) infrared imagery of this area indicates that certain marsh species may be differentiated by temperature-sensing instruments. Sources of ground water and heated water from a power plant are also delineated. Author

N71-11158*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

A THERMAL SURVEY OF THE CONNECTICUT RIVER ESTUARY

F. H. Ruggles, Jr. In its 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 3 1969 12 p ref

Avail: NTIS CSCL08H

The effects of atomic power plant heated effluent on the marine life in river estuary were studied by water measurements and aerial infrared imagery. Analysis of thermal data mapping indicated heat plume flow patterns of the heated effluent until it fully occupied the estuary on a downstream flow. These data indicated the heat plume dispersion and revealed differences in river water flow density. G.G.

N71-11160*# Geological Survey, Tacoma, Wash.

SNOW AND ICE SENSING WITH PASSIVE MICROWAVE AND GROUND TRUTH INSTRUMENTATION: RECENT

06 HYDROLOGY AND WATER MANAGEMENT

RESULTS, SOUTH CASCADE GLACIER

M. Meier and A. T. Edgerton *In* NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 3 1969 15 p refs Prepared in cooperation with Aerojet-Gen. Corp., El Monte, Calif.

Avail: NTIS CSCL08L

Field experiments utilizing a multifrequency microwave radiometry field laboratory were conducted in the Pacific Northwest to assess the effects of melting, layering surface roughness, density variations, etc. on microwave emission and to determine effective penetration as a function of sensor wavelength. Laboratory studies involved measurement of the dielectric properties of snowpacks at microwave frequencies. Analytical modeling consisted of formulation of models to describe vertically structured media in which both the dielectric properties and physical temperature are permitted to vary with depth. During field studies, the investigators experienced difficulty in obtaining reliable ground truth measurements of snow moisture. To improve confidence in this measurement, a series of tests were conducted on the South Cascade Glacier where several techniques for determining snow moisture were compared. The investigators are also analyzing 1.55-cm imagery of Mount Rainier where effects of terrain slopes parallel and perpendicular to the flight line are encountered. These data correspond to a variety of snow and ice conditions. Author

N71-11161*# Geological Survey, Townson, Md.

USE OF INFRARED RADIOMETRY IN MEASURING GROUND-WATER INFLOW TO STREAMS, DELMARVA PENINSULA, MARYLAND AND DELAWARE

Este F. Hollyday *In* NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 3 1969 15 p refs

Avail: NTIS CSCL08H

A convective heat budget is used to calculate ground-water inflow to small alluvial streams. Stream temperatures are measured radiometrically from aircraft flying along a stream; upstream discharge and ground-water inflow temperature are measured by a ground team. Ground-water inflow temperature are measured by a ground team. Ground-water inflow and downstream discharge may be calculated for any desired subreach within the reach flown. Time required for data collection may be greatly reduced as compared with time required to make a seepage run. Ground-water inflow to a reach of Beaverdam Creek near Milton, Delaware, is calculated to be 5.7 cubic feet per second, which agrees within 11 percent with the inflow determined by standard stream-gaging techniques. Downstream discharge is calculated to be 9.1 cubic feet per second, which agrees within 7.5 percent. Author

N71-11162*# Geological Survey, Washington, D.C.

PRELIMINARY REPORT ON REMOTE SENSING IN WATER-RESOURCES STUDIES IN YELLOWSTONE NATIONAL PARK, WYOMING

Edward R. Cox *In* NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 3 1969 10 p

Avail: NTIS CSCL08H

Data obtained from remote sensing should be useful in locating bodies of cool ground water near thermal-water areas in Yellowstone National Park. Remote-sensing data, particularly infrared imagery, from aircraft missions are being studied, and methods of interpretation are being developed to correlate remote-sensing and ground-truth data. Test areas are being established where hydrologic ground-truth data can be obtained to correlate with imagery. Areas that show promise for correlation of imagery and ground-truth data are outlined. Patches of snow observed correlated exactly with relatively cool areas interpreted from infrared imagery. Author

N71-11170*# New York Univ., N.Y. Dept. of Biology.

THE STUDY OF COASTAL ECOLOGY USING REMOTE PHOTOGRAPHY

Mahlon G. Kelly *In* NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 3 1969 17 p

Avail: NTIS CSCL08A

Photointerpretation of aerial photography aided by field surveys has been used at three test sites in the region of the Florida Straits in order to determine the application of such photography to coastal ecological studies. It was found that the photography enabled identification and location of major unusual or unrecognized features, mapping and generalization of biotic bottom cover, and delineation of ecological relationships. Man-made features and pollution could be identified and studied. Author

N71-14697# National Environmental Satellite Center, Washington, D.C.

ANNOTATED BIBLIOGRAPHY OF REPORTS, STUDIES, AND INVESTIGATION RELATING TO SATELLITE HYDROLOGY

D. R. Baker, A. F. Flanders, and M. Fleming Jul. 1970 32 p refs

(PB-194072; ESSA-TM-NESCTM-10) Avail: NTIS CSCL 13B

The bibliography is on applications of satellite data to hydrologic problems confronting ESSA's mission. Author (USGRDR)

N71-14756# Allied Research Associates, Inc., Concord.

THE USE OF ENVIRONMENTAL SATELLITE DATA FOR MAPPING ANNUAL SNOW-EXTENT DECREASE IN THE WESTERN UNITED STATES Final Report

James C. Barnes and Clinton J. Bowley Jun. 1970 111 p refs (Contract ESSA-E252-69(N))

(PB-194004; ARA-8G72-F) Avail: NTIS CSCL08L

Techniques to map areal snow extent from environmental satellite photography are tested in three regions of the western United States during the 1967 and 1969 snowmelt seasons. The three regions, each with characteristically different terrain, forest cover, and snowfall climatologies, are: (1) the southern Sierra Nevada in California, (2) the Upper Columbia Basin in Idaho and Montana, and (3) the Salt River Project Area in Arizona. The principal data sample is AVCS photography from the ESSA satellites; in addition, IDCS photography and daytime HRIR data from the Nimbus 3 satellite are also examined. Snow-extent measurements from aerial surveys are used as ground-truth data. The results indicate that of the three regions tested satellite imagery provides the most reliable measurements of snow extent in the southern Sierras. In the Kings River Basin, the satellite snow-line elevation is within 500 feet of the aerial-survey snow-line elevation, with the satellite value being higher in 10 of 11 cases analyzed. Author (USGRDR)

N71-16141*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

RADAR AND INFRARED IMAGERY, OREGON AND WASHINGTON COASTS

Norman S. MacLeod and Parke D. Snavely, Jr. *In* its Earth Resources Aircraft Program Status Rev., Vol. 1 1968 8 p

Avail: NTIS CSCL08F

Radar and infrared imagery were used to study the geology of coastal Oregon and Washington. Obtained side-looking radar imagery mappings established topographic expressions of lithologic and structural features including the extension of a large geological fault. Infrared aerial imagery provided current patterns in offshore waters, a fault as a faint thermal lineation caused by water seepage, large-scale sand waves in tidal flats, and extensions of fresh water plums seaward from the mouths of several rivers G.G

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N71-16142*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

PROGRESS IN APPLICATION OF REMOTE-SENSING TECHNIQUES TO MARINE GEOLOGY AND HYDROLOGY

Ernest H. Latham *In its Earth Resources Aircraft Program Status Rev., Vol. 1 1968 2 p*

Avail: NTIS CSCL08J

Aerial infrared imagery and radiometer surveys, together with geochemical sampling of the water column and bottom sediments established the abundance of most major and minor ions in four cross sections of the San Francisco Bay. Color photograph interpretations of the Texas coastal area revealed that washover scars caused by hurricanes recurred in the same places and that an island dune field migrated westward. G.G.

N71-16167*# Geological Survey, Tacoma, Wash.

EVALUATION OF SOUTH CASCADE GLACIER TEST SITE RESULTS

M. F. Meier *In NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 3 1968 17 p refs*

Avail: NTIS CSCL08F

Remote sensor studies were carried out to determine the best methods for detecting the presence or absence of snow and ice and the preciseness with which the surface temperature can be measured, to differentiate the type of material, to measure the thickness, density, and liquid water content of snow, and to determine the effects of time of day, weather, and terrain on the measurement results. The various techniques used in the studies are described. R.B.

N71-16170*# Geological Survey, Washington, D.C.

USE OF REMOTE SENSORS IN CLASSIFYING LAKES IN WEST-CENTRAL FLORIDA

J. W. Stewart *In NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 3 1968 11 p ref*

Avail: NTIS CSCL08F

The application of remote sensors to problems of lake hydrology is discussed with respect to the optimum parameters that can be used: (1) for establishing a system of classification of lakes in a karst topography, (2) developing a classification of the shoreline features of lakes to establish average high-water marks historically significant to the hydrology of the area, and (3) determining the interrelations between different classes of lakes and their occurrence and effects on the hydrological regime of an area. Author

N71-16171*# Geological Survey, Miami, Fla. Water Resources Div.

REMOTE-SENSING APPLICATIONS TO HYDROBIOLOGY IN SOUTH FLORIDA

Milton C. Kolipinski and Aaron L. Higer *In NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 3 1968 43 p refs*

Avail: NTIS CSCL08F

Results are presented of a continuing effort in the application of remote-sensing data as a tool in hydrobiological investigations in the Everglades and coastal regions of south Florida. Panchromatic, color, color infrared, and multiband photographs used individually and in combination show gross, as well as detailed, features that permit evaluation of water resources. Hydrologic features such as depth and size of the basins and drainage patterns are easily measured or observed from the photographs. The distribution of aquatic and semiaquatic plants serves as an indicator of hydrologic conditions. Examples are the occurrence of red and black mangrove

trees along the tropical shorelines of Florida, which would indicate the mean high-water level; also, the particular reflections on photographs from algal mats and emergent aquatic plants allow for the delineation of the fresh-water/brackish-water interface. These observations were made even from orbital photography at an altitude greater than 150 miles. Multiband imagery shows potential in extracting the spectral signatures of willow and fig trees and cattail marshes in the Everglades. The findings have transfer value to other marsh, swamp, and coastal regions of the United States. Author

N71-16172*# Geological Survey, Philadelphia, Pa.

ESTUARINE STUDIES

Richard W. Paulson *In NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 3 1968 10 p*

Avail: NTIS CSCL08F

The objective of the estuarine remote-sensing program is to determine the feasibility of using remote sensors for studying estuaries from aircraft or spacecraft platforms. The particular objectives of the Delaware Estuary Program are to determine whether variations in water quality, which are known to exist in this highly polluted water body, can be detected remotely and to devise methods for using remote-sensing data to solve estuarine problems. Author

N71-16173*# Geological Survey, Towson, Md.

USE OF INFRARED IMAGERY TO LOCATE SURFICIAL AQUIFERS, DELMARVA PENINSULA, MARYLAND AND DELAWARE

Esté F. Hollyday *In NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 3 1968 14 p refs*

Avail: NTIS CSCL08F

Infrared imagery was tested as a rapid reconnaissance technique for locating the thickest sections of water-bearing surficial sand in order to augment a conceptual hydrogeologic framework that will facilitate orderly development and management of water supplies. Imagery obtained from NASA aircraft overflights in July 1967 and January 1968 recorded the relative temperature of visible water along a control line, where the hydrogeology had been studied in detail, and along six test lines. Data were analyzed by noting all parts of surface-water bodies that appeared to have pronounced anomalous temperatures. The location of the three strongest and most diffuse thermal anomalies seemed to be controlled by the following hydrogeologic constraints: (1) areas of thick surficial sands, (2) short reaches of major streams almost immediately above the head of estuaries, and (3) the absence of fine-grained marine sediments overlying the surficial sand aquifers. Author

N71-16174*# Geological Survey, Washington, D.C.

REMOTE SENSING OF MARSHLANDS AND ESTUARIES USING COLOR INFRARED PHOTOGRAPHY

Richard R. Anderson *In NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 3 1968 23 p refs*

Avail: NTIS CSCL08F

Remote-sensing techniques, particularly color infrared photography, are discussed as a rapid method of investigating estuaries and marshlands. Experimentation with color infrared film and various Wratten filters (15-G, 25-A, 61, 89-B) in estuarine and marshland studies of the Patuxent River, Maryland is considered. Conclusions are that color infrared film with use of various filters provides information on various water-quality parameters and vegetation composition not obtainable using other remote-sensing methods. The Wratten 15-G filter appears to be the most useful.

put the Wratten 25-A filter may be superior in delineation of submerged aquatic plants. The Wratten 61 and 89-B filters provide a tool for specific plant type, distribution in marshes, and shoreline delineation. Author

N71-16175* Illinois Univ., Chicago.

APPLICATION OF RADAR IMAGERY TO DRAINAGE ANALYSIS

Roger M. McCoy In NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 3 1968 18 p ref

Avail: NTIS CSCL08F

Radar imagery was investigated for application in drainage analysis, with data taken from a K-band imaging system and U. S. Geological Survey topographic maps of the same drainage basins. The drainage basins were selected from a variety of terrain types including low, moderate, and high relief grasslands and forests. Procedures were established for drawing the stream network from topographic maps. Interpretation of the data included production of maps of the drainage network and morphometric analysis of drainage composition. R.B.

N71-18354* South Dakota State Univ., Brookings. Remote Sensing Inst.

REMOTE SENSING OF HYDROLOGIC RESOURCES IN THE GREAT PLAINS Final Report

F. A. Waltz and V. I. Myers Jun. 1970 108 p refs

(Contract DI-14-08-0001-G-25)

(PB-195451; USGS-DO-70-009; USGS-202; Rept-1) Avail: NTIS CSCL08H

The feasibility of a data handling system for measuring and disseminating cropland soil moisture information from ERTS spacecraft data was studied. Large significant correlations were found between optical density measured on aerial film and soil water content measured by neutron probe methods, also between ground temperatures as measured through infrared thermal scanner techniques and soil water content of fallow or bare soil. Least square analyses of variance indicated crops, days and the interaction of crops by days as highly significant sources of variation in the data and the need for an absolute reference in conjunction with aerial data. It has been concluded that not only soil water content but plant water content and available soil water must be measured. Author (GRA)

N71-19257* Geological Survey, Corpus Christi, Tex.

REMOTE SENSING TECHNIQUES AS APPLIED TO COASTAL SEDIMENTATION, SOUTH TEXAS

Henry L. Berryhill, Jr. In NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 1 1969 15 p

Avail: NTIS HC\$6.00/MF\$0.95 CSCL08G

A U. S. Geological Survey to study processes of sedimentation along the south Texas coast as a part of its Marine Geology Program is reported. The purposes of the study are to develop principles that can be used in studying and comparing coastal processes in general and to establish guidelines that can be used for the efficient management of not only the south Texas coast but other barrier coastlines of the United States. Remote-sensing techniques are applied as a complement to the regular field investigations in order to evaluate the usefulness of remote sensing in several aspects of the study of sedimentation processes: 1) to determine bottom topography in shallow water; 2) to show the morphology of sand bodies in the several environments of deposition: shallow marine, barrier island and lagoon; 3) to determine the movement pattern of sediments in suspension at a given time and under a specific climatic and sea state condition; and 4) to monitor the coastline on a sequential basis as a means of relating rates of sediment movement to current patterns, sea state and atmospheric

conditions. Special emphasis is on measuring rates of erosional healing following major storms or hurricanes. Author

N71-19410* Rhode Island Univ., Kingston.

CRITERIA FOR RECOGNITION OF ESTUARINE WATER POLLUTION BY AERIAL REMOTE SENSING Technical Report, 1 Jul. 1969 - 30 Jun. 1970

John J. Fisher 30 Jun. 1970 15 p refs

(Contract DI-14-31-0001-3040)

(PB-195976; W71-01900) Avail: NTIS CSCL 13B

Multispectral aerial photographic remote sensing analysis was made of water quality in estuarine areas. Photographic interpretation was compared with ground-truth data. Four film emulsions proved most efficient: panchromatic, black and white infrared, color, and color infrared. A simple inexpensive four camera system using these films was designed and developed. Author (GRA)

N71-21296* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

OBSERVATIONS OF THE INLAND DELTA OF THE NIGER RIVER BY NIMBUS 3 HIGH-RESOLUTION INFRARED RADIOMETER (HRIR)

N. H. MacLeod Aug. 1970 14 p

(NASA-TM-X-65469; X-652-70-315) Avail: NTIS CSCL08E

The HRIR imaging of earth-surface features in daytime depends upon differences in reflectance of water, sand, vegetation, clouds, and other surfaces. The series of HRIR images showing the inland delta of the Niger River demonstrates the use of such data in natural resource studies. The information gleaned from the imagery on seasonal plant and surface-water changes in the inland delta is based on two features of HRIR that are unique in space photography: the distinct contrasts between surface water and most other surface features, and the repetitive (daily) large-scale coverage of the area, which generates a time-lapse series of images of changing phenomena. Author

N71-22834* Israel Program for Scientific Translations, Ltd., Jerusalem.

ILLUSTRATED GLOSSARY OF SNOW AND ICE

A. O. Shpaikher In *its Probl. of the Arctic and the Antarctic* 1970 p 266-268 refs

Copyright. Avail: NTIS HC\$6.00/MF\$0.95

The revised edition of the Illustrated Glossary makes extensive use of previously published ice albums, glossaries, manuals, and investigations by scientists of the United Kingdom, U.S.S.R., United States, Germany, Denmark, Iceland, Norway, Finland, France, and Sweden. The section of the glossary dealing with definitions and linguistic equivalents is arranged alphabetically and furnishes not only the terminology but definitions and brief explanations. In addition to the English terminology, it supplies the Danish, Finnish, French, German, Icelandic, Norwegian, Russian, and Spanish equivalents, which make the dictionary especially valuable and an indispensable reference in studying scientific works published in different countries. A.L.

N71-35483* Soil Conservation Service, Anchorage, Alaska.

SUMMARY OF SNOW SURVEY MEASUREMENTS FOR ALASKA

T. G. Freeman 1 Nov. 1970 114 p

Avail: NTIS

All snow survey data are arranged alphabetically by snow course. A map showing the location of the Alaska snow courses, the map number, and the snow course number is provided to aid in locating the data record for any of the Alaska stations. An alphabetical and a numerical index are also provided before the data summary sheets. Biographical information concerning each snow course is provided at the head of each snow course data sheet. This includes the identifying number, elevation above sea level, basin and stream in which it is situated, and location by latitude and longitude. In the data tables, the heading entitled

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YEAR is the terminal value of the water year. That is, 1968 means the 1967-68 water year, or more specifically, October 1, 1967 to September 30, 1968. Author

N71-36747# Arctic Inst. of North America, Washington, D.C.
INFRARED RADIANT TEMPERATURES IN THE ALPINE/PERIGLACIAL ENVIRONMENT AS RELATED TO THERMAL REMOTE SENSING
Ray Leonard Lougeay (Ph.D. Thesis - Mich. Univ., Ann Arbor)
Jul. 1971 123 p refs
(Contract DAHCO4-67-C-0047)
(AD-726958; AINA-RP-60) Avail: NTIS CSCL 08/12

Observations were conducted in the St. Elias Mountains, Yukon Territory, Canada to determine some aspects of the applicability of thermal remote sensing in the alpine/periglacial environment. Techniques of ground truth observations were tested by which a researcher might determine the usefulness of infrared scanning to his study without the financial investment of airborne remote sensing on a trial-and-error basis. Also, an attempt was made to determine the environmental controls upon radiant temperature by monitoring changing patterns of radiant temperature relative to changing meteorologic conditions. Observations of both actual and thermal infrared radiant temperatures were made over various environmental surfaces in the alpine/periglacial environment. These surfaces included various types of ice-cored moraine, glacial ice, and morainic outwash at the terminal margins of a large valley glacier.

Author (GRA)

N72-11323*# Texas A&M Univ., College Station. Environmental Engineering Div.

A PRACTICAL METHOD OF DETERMINING WATER CURRENT VELOCITIES AND DIFFUSION COEFFICIENTS IN COASTAL WATERS BY REMOTE SENSING TECHNIQUES

Wesley P. James Oct. 1971 28 p refs
(Grants NGL-44-001-001; IAC-(72-73)-156)

(NASA-CR-123314; RSC-34) Avail: NTIS CSCL 08C

A simplified procedure is presented for determining water current velocities and diffusion coefficients. Dye drops which form dye patches in the receiving water are made from an aircraft. The changes in position and size of the patches are recorded from two flights over the area. The simplified data processing procedure requires only that the ground coordinates about the dye patches be determined at the time of each flight. With an automatic recording cinematograph for measuring coordinates and a computer for processing the data, this technique provides a practical method of determining circulation patterns and mixing characteristics of large aquatic systems. This information is useful in assessing the environmental impact of waste water discharges and for industrial plant siting. Author

N72-11324*# Texas A&M Univ., College Station. Environmental Engineering Div.

QUANTITATIVE EVALUATION OF WATER QUALITY IN THE COASTAL ZONE BY REMOTE SENSING

Wesley P. James Sep. 1971 70 p refs
(Grants NGL-44-001-001; IAC-(72-73)-156)

(NASA-CR-123313; RSC-33) Avail: NTIS CSCL 08A

Remote sensing as a tool in a waste management program is discussed. By monitoring both the pollution sources and the environmental quality, the interaction between the components of the estuarine system was observed. The need for in situ sampling is reduced with the development of improved calibrated, multichannel sensors. Remote sensing is used for: (1) pollution source determination, (2) mapping the influence zone of the waste source on water quality parameters, and (3) estimating the magnitude of the water quality parameters. Diffusion coefficients and circulation patterns can also be determined by remote sensing, along with subtle changes in vegetative patterns and density. J.A.M.

N72-11363# Aeronautical Chart and Information Center, St. Louis, Mo. Research Div.

ON THE PORTRAYAL OF NATURAL RIVER VALLEY PHENOMENA ON SMALL-SCALE PHYSICAL MAPS [OB IZOBRAZHENII PRIRODNYKH YAVLENIY PO DOLINAM REK NA MELKOMASSHTABNYKH KARTAKH PRIRODY]
T. V. Kotova and V. V. Mestennikova May 1971 10 p Transl. into ENGLISH from Geodeziya i Kartografiya, USSR, no. 12, 1970 p 61-64

(AD-726787; ACIC-TC-1739) Avail: NTIS CSCL 08/2

The paper discusses the problems concerning the principles of representation of valley contours on physical maps, particularly on small-scale geomorphological maps published for scientific reference purposes. Author (GRA)

N72-12295*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

THIRD ANNUAL EARTH RESOURCES PROGRAM REVIEW. VOLUME 3: HYDROLOGY AND OCEANOGRAPHY

1970 351 p refs Conf. held at Houston, Tex., 1-3 Dec. 1970
Original contains color illustrations 3 Vol.
(NASA-TM-X-87406; MSC-03742-Vol-3) Avail: NTIS HC \$6.00/MF \$0.95 CSCL 08C

Hydrological and meteorological investigations undertaken in conjunction with the Earth Resources Program are briefly described along with discussions of important results obtained.

N72-12297*# South Dakota State Univ., Brookings. Remote Sensing Inst.

REMOTE SENSING FOR DEFINING AQUIFERS IN GLACIAL DRIFT

Victor I. Myers /In NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 20 p refs
Sponsored by NASA and Geological Surv.

Avail: NTIS HC \$6.00/MF \$0.95 CSCL 08H

Investigations were undertaken to determine the properties of shallow aquifers and related features that influence electromagnetic energy, to determine how these properties can be detected remotely, and to establish remote sensing procedures for aiding in ground water mapping. The direct influence of aquifer characteristics on surface thermal contrasts is discussed. Conclusions reached for late summer, predawn missions were: (1) Dynamic thermal changes near the surface can be used for thermal infrared sensing to detect shallow aquifers in glacial drift. (2) Under ideal conditions, surface temperatures may be used to predict certain features related to the occurrence of shallow aquifers. (3) The timing of missions and the optimum meteorological conditions occurring prior to and during the mission are critical for night thermal missions. (4) Repetitive flights made under variable conditions provide additional evidence to verify the occurrence of shallow aquifers. (5) Imagery from this investigation, along with ERTS-simulated imagery, indicates the feasibility of applying ERTS A and B data to reconnaissance studies for detection of shallow aquifers. A.L.

N72-12300*# Geological Survey, Tacoma, Wash.

EMISSION CHARACTERISTICS OF SNOW AND ICE IN THE MICROWAVE RANGE

Mark F. Meier and A. T. Edgerton (Aerojet-Gen. Corp., El Monte, Calif.) /In NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1971 8 p Prepared in cooperation with Aerojet-Gen. Corp., El Monte, Calif.

Avail: NTIS HC \$6.00/MF \$0.95 CSCL 08L

Some results are presented of a two year investigation on microwave emissions from snow. Included in the investigation were: theoretical studies; laboratory measurements of electrical properties of snow and similar materials; numerical modelling of hypothetical and real snowpacks; analysis of microwave data obtained on overflights; and quantitative measurements of natural and artificial snowpacks made in the field. Results indicate that a fairly simple combination of microwave polarizations and frequencies can ultimately be used to monitor the water equivalent and free-water content as well as the distribution of snow. This understanding may also shed light on the physics of microwave emission from other wet, granular, layered media.

Author

N72-12301*# Geological Survey, Albany, N.Y.
MANAGEMENT APPLICATIONS FOR THERMAL IR
IMAGERY OF LAKE PROCESSES

J. M. Whipple and R. B. Haynes (RADC) *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1971 13p

Avail: NTIS HC \$6.00/MF \$0.95 CSCL 14E

A thermal infrared scanning program was conducted in the Lake Ontario Basin region in an effort to determine: (1) limonologic data that could be collected by remote sensing techniques, and (2) local interest in and routine use of such data in water management programs. Difficulties encountered in the development of an infrared survey program in New York suggest that some of the major obstacles to acceptance of remotely sensed data for routine use are factors of psychology rather than technology. Also, terminology used should suit the measurement technique in order to encourage acceptance of the surface thermal data obtained. A.L.

N72-12302*# National Aeronautics and Space Administration.
Manned Spacecraft Center, Houston, Tex.

SPECTRAL REFLECTANCE CHARACTERISTICS AND
AUTOMATED DATA REDUCTION TECHNIQUES WHICH
IDENTIFY WETLAND AND WATER QUALITY CONDITIONS
IN THE CHESAPEAKE BAY

Richard R. Anderson *In* its 3d Ann. Earth Resources Program Rev., Vol. 3 1970 29 p refs

Avail: NTIS HC \$6.00/MF \$0.95 CSCL 14E

Progress on research designed to test the usability of multispectral, high altitude, remotely sensed data to analyze ecological and hydrological conditions in estuarine environments is presented. Emphasis was placed on data acquired by NASA aircraft over the Patuxent River Chesapeake Bay Test Site, No. 188. Missions were conducted over the Chesapeake Bay at a high altitude flight of 18,460 m and a low altitude flight of 3070. The principle objectives of the missions were: (1) to determine feasibility of identifying source and extent of water pollution problems in Baltimore Harbor, Chesapeake Bay and major tributaries utilizing high altitude, ERTS analogous remote sensing data; (2) to determine the feasibility of mapping species composition and general ecological condition of Chesapeake Bay wetlands, utilizing high altitude, ERTS analogous data; (3) to correlate ground spectral reflectance characteristics of wetland plant species with tonal characteristics on multispectral photography; (4) to determine usefulness of high altitude thermal imagery in delineating isotherms and current patterns in the Chesapeake Bay; and (5) to investigate automated data interpretive techniques which may be usable on high altitude, ERTS analogous data. Author

N72-12304*# Geological Survey, Harrisburg, Pa.
THE ROLE OF REMOTELY SENSED AND RELAYED DATA
IN THE DELAWARE RIVER BASIN

Richard W. Paulson *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 19 p refs

Avail: NTIS HC \$6.00/MF \$0.95 CSCL 14E

A discussion is presented of the planned integration of the existing Delaware River Basin water quality monitoring and data processing systems with a data relay experiment proposed for the Earth Resources Technology Satellite (ERTS)-A, which will be launched in 1972. The experiment is designed to use ERTS-A as a data relay link for a maximum of 20 hydrologic stations in the basin, including streamgaging, reservoir level, ground water level, and water quality monitoring stations. This experiment has the potential for reducing the timelag between data collection and dissemination to less than 12 hours. At present there is a significant timelag between the time when the data are recorded at a monitoring site and the water resources agencies receive the data. The timelag exists because most of these instruments operate in remote locations without telemetry, and the data records are removed manually, generally at a weekly frequency. For most water quality monitoring, the data do not reach water resources agencies for a period of 2 weeks to 2 months. Author

N72-12306*# National Oceanic and Atmospheric Administration.
Washington, D.C.

NOAA'S HYDROLOGY STUDIES UNDER THE EARTH
RESOURCES SURVEY PROGRAM

E. Paul McClain *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1971 9 p refs

Sponsored by NASA
 Avail: NTIS HC \$6.00/MF \$0.95 CSCL 08H

Results are presented of investigations of soil moisture, snow cover, and lake temperatures carried out with the support of the Earth Resources Survey Program. Objectives of these studies were: (1) Obtain more data with a multifrequency microwave system so that the range of soil moisture amounts and types can be extended. (2) Establish instrument and data specifications for microwave sensing of soil moisture from satellites and aircraft. (3) Refine the procedures for mapping snow cover that have been developed using satellite and aircraft remote sensor data in the visible spectrum. (4) Evaluation of satellite and aircraft infrared observations for determining their information content with respect to snow cover, ice cover, and water temperature over large lakes. A.L.

N72-13307# Aerojet-General Corp., El Monte, Calif. Microwave
Div.

MICROWAVE RADIOMETRIC INVESTIGATIONS OF
SNOWPACKS Final Report, 20 Aug. 1968 - 1 Sep. 1970

A. T. Edgerton, A. Stogryn, and G. Poe Jul. 1971 89 p refs
 (Contract USGS-14-08-001-11828)

(IR-USGS-230; DI-DO-71-018; Rept-1285R-4) Avail: NTIS

Basic and applied research into the microwave radiometric emissions of snowpacks encompassed multifrequency measurements of a large variety of snowpacks, numerical modeling of snowpack emission, dielectric constant measurements and techniques, and laboratory bistatic reflectivity measurements of selected snow samples. Experiments demonstrated that direct empirical relationships exist between snowpack and water equivalent and its microwave emission. Theoretical studies which accounted for subsurface snow structure provided mainly qualitative reasons for interpretation of results, but generally did not agree with measured data, probably owing to the inadequacy of present snowpack models to account for nonspecular surface scattering associated with small-scale surface irregularities and volume scattering associated with random volume inhomogeneities. Author

N72-14338 Department of Energy, Mines and Resources,
Ottawa (Ontario).

RESOURCE SATELLITES AND REMOTE AIRBORNE
SENSING FOR CANADA. REPORT NO. 8: WATER
RESOURCES

1971 32 p

(M75-2/8) Copyright. Avail: NTIS

The use of remote sensors mounted in Earth Resources Technology Satellites and other manned-unmanned satellites to determine water resources in Canada is discussed. Items of consideration are: (1) how to handle and interpret the data obtained from satellite observations, (2) determination of the pertinent remote sensing observables and their relative importance and value, and (3) to identify research programs which could benefit from such a program. The organization and funding involved in the project are described. Author

N72-14366# Department of Energy, Mines and Resources,
Ottawa (Ontario).

RESOURCE SATELLITES AND REMOTE AIRBORNE
SENSING FOR CANADA. REPORT NO. 7: ICE
RECONNAISSANCE AND GLACIOLOGY

1971 44 p

(M75-2/7) Avail: NTIS

The application of satellite-borne remote sensors for reporting ice formations and glacier expanse is discussed. Rapid expansion of northern transportation has increased the requirements for accurate reporting of ice formations. The satellite program is complementary to current ice reconnaissance programs. Benefits resulting from the satellite observation program and details of the operation are included. Author

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N72-14371# Indian National Scientific Documentation Centre, New Delhi.

APPLICATION OF AERIAL METHODS IN GROUND WATER STUDIES

N. G. Kell 1971 294 p refs Transl. into ENGLISH of "Primenenie Aerometodov dlya Izucheniya Gruntovykh Vod" Leningrad, Izd. Akad. Nauk SSSR, 1962 Prepared for Dept. of Com., ESSA, and NSF (Contract NSF C-466)

(TT-68-50638; TT-70-57236) Avail: NTIS

The problem of using aerial survey methods for ground water prospecting in desert, semidesert, and forest zones of the USSR is examined. The data were obtained during expeditions of the Laboratory of Aerial Survey Methods, which carried out special studies in Turkmenia, regions of the sub-Caspian lowlands, and in the northwestern territory of the Russian Plains. Decamouflaging indicators of ground water occurrence and methods of recognizing them on aerial photographs according to different landscape types are described. Author

N72-16324# Illinois Univ., Urbana. Dept. of Civil Engineering. PHOTOGRAMMETRY AS A TOOL FOR HYDRAULIC SURFACE STUDIES

Wolfgang Faig Aug. 1971 32 p refs (PB-202280; UULU-ENG-71-2022; Photogrammetry-Ser-31) Avail: NTIS CSCL 08H

The optical behavior of water surfaces is described, and the feasibility of using photogrammetric techniques to determine water depths is investigated. GRA

N72-17306# Montana State Univ., Bozeman. INFRARED TEMPERATURE SENSING OF SNOW-COVERED TERRAIN

Bernard A. Shafer and Arlin B. Super Aug. 1971 104 p refs (Contract DAHC04-67-C-0058) (AD-732849; AROD-7166-1-EN) Avail: NTIS CSCL 08/12

The feasibility of remotely monitoring snow surface temperatures was investigated with a Barnes IT-3 infrared thermometer. Much of the work concentrated on determining the vertical emissivity of dry snow in the atmospheric infrared window region between 8 and 14 microns. The emissivity of various snow surface types was measured using an apparatus called an emissivity box. An average emissivity for the freshly fallen snow was found to be 0.975. An analysis of errors in radiometrically obtained snow surface temperatures revealed that the IT-3 is capable of accurately measuring the true surface temperature to within two degrees Celsius for the temperature range experimented. Remote radiometric temperature sensing of snow surfaces appears to offer a potentially useful tool for monitoring surface temperature gradients in arctic environments. Author (GRA)

N72-17984# Wisconsin Univ., Madison. Water Resources Center. PROCEEDINGS OF THE NATIONAL SYMPOSIUM ON DATA AND INSTRUMENTATION FOR WATER QUALITY MANAGEMENT

Dec. 1970 535 p refs Conf. held at Madison, Wis., 21-23 Jul. 1970 (OWRR Proj. A-99-WIS(13)) (PB-203150; W71-08550) Avail: NTIS HC \$6.00/MF \$0.95 CSCL 13B

The central theme of the symposium was to assess the benefits offered by advanced data collection, analysis and display systems toward the enhancement of the nation's environment. Under this framework, the symposium considered case studies where advanced systems were in operation and experience has been gained, and explored the results of recent research on several topics. Author (GRA)

N72-18346# Geological Survey, Bismarck, N.Dak. Water Resources Div. THERMAL STUDY OF THE MISSOURI RIVER IN NORTH DAKOTA USING INFRARED IMAGERY

Orlo A. Crosby 1971 51 p refs Sponsored by NASA Original contains color illustrations (NASA-CR-125639) Avail: NTIS CSCL 08H

Studies of infrared imagery obtained from aircraft at 305- to 1,524-meter altitudes indicate the feasibility of monitoring thermal changes attributable to the operation of thermal electric plants and storage reservoirs, as well as natural phenomena such as tributary inflow and ground water seeps in large rivers. No identifiable sources of ground water inflow below the surface of the river could be found in the imagery. The thermal patterns from the generating plants and the major tributary inflow are readily apparent in imagery obtained from an altitude of 305 meters. Portions of the tape-recorded imagery were processed in a color-coded quantization to enhance the displays and to attach quantitative significance to the data. The study indicates a marked decrease in water temperature in the Missouri River prior to early fall and a moderate increase in temperature in late fall because of the Lake Sakakawea impoundment. Author

N72-18353# Geological Survey, Washington, D.C. AERIAL INFRARED RECONNAISSANCE OF THE STEAMBOAT SPRINGS AREA NEVADA

R. M. Moxham and Gordon W. Greene Dec. 1968 40 p refs (NASA Order T-65754-G) (NASA-CR-125651; USGS-IR-NASA-141) Avail: NTIS CSCL 08G

The aerial IR technique quickly and efficiently delineates high temperatures associated with the first order phenomena of convective heat transfer in major geothermal systems. A reconnaissance geophysical exploration for such geothermal systems in the Steamboat Springs area Nevada, is reported. The infrared (IR) radiance of the terrain is mapped and a preliminary assessment of its relation to the thermal activity is made. Author

N72-20346# California Univ., Davis. Dept. of Water Science and Engineering. USER REQUIREMENTS FOR THE APPLICATION OF REMOTE SENSING IN THE PLANNING AND MANAGEMENT OF WATER RESOURCE SYSTEMS

Robert H. Burgy, David R. Storm, and Maurice L. Horton In its An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Tech. 1 Jan. 1972 22 p refs

Avail: NTIS HC \$6.00/MF \$0.95 CSCL 08H

Research results analyze hydrologic and water resource systems; establish the major parameters needed to meet the informational requirements of water resource managers; specify when and where data are needed; and suggest the relative merits of classic techniques vs. remote sensing techniques for acquisition of the necessary data. The fundamental framework within which the analysis was made is a model of the hydrological and water resources systems and their discrete subsystems. The subsystems identified within the model are: (1) evaporation (evapotranspiration); (2) vegetation (includes soil-vegetation interrelation); (3) rain and snow; (4) streams and estuaries; (5) reservoirs and lakes; (6) unsaturated soil zone; and (7) saturated zone. A.L.

N72-20348# California Univ., Los Angeles. RIVER MEANDER STUDIES

Richard Lingenfelter and Gerald Schubert In its An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Tech. 1 Jan. 1972 19 p

Avail: NTIS HC \$6.00/MF \$0.95 CSCL 08H

Research is underway to develop a relatively simple and inexpensive technique to assess the water resources of large, relatively undeveloped geographical areas in order that comprehensive water development plans may be prepared with less expenditure of money and time for the collection of data on the earth surface. Investigations are being made to determine if it will be possible to extract data on the total discharge of a river, both past and present, from satellite television photography of river meander patterns. Geomorphological investigations of possible correlations between the stream meander power spectrum

and the stream discharge frequency distribution have been made for the Feather River in northern California. Procedures for generating the stream discharge probability density functions and meander power spectra for other rivers are described. A.L.

N72-20349* California Univ., Santa Barbara. Dept. of Geography.

ASSESSMENT OF THE IMPACT OF THE CALIFORNIA WATER PROJECT ON THE WEST SIDE OF THE SAN JOAQUIN VALLEY

John E. Estes, Leslie W. Senger, Lyndon Wester, James Viellenave, Patrick Fortune, Bruce Davis, and Thomas Soper *In its* An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Tech. 1 Jan. 1972 35 p Original contains color illustrations

Avail: NTIS HC \$6.00/MF \$0.95 CSCL 08H

Investigations are being conducted of various regional scale parameters that can be used to characterize the nature of the area transformation that is taking place in the San Joaquin Valley. Information is being extracted from remote sensing imagery for: land use, general and urban-oriented; vegetation, general and problem oriented (boron and salinity affected areas); irrigation systems; and identification of crops. A.L.

N72-20350* California Univ., Riverside. Dept. of Geography. **ASSESSMENT OF THE IMPACT OF THE CALIFORNIA WATER PROJECT IN SOUTHERN CALIFORNIA**

Leonard W. Bowden, William G. Brooner, V. B. Coleman, D. Goehring, R. A. Minnich, D. A. Nichols, and J. Viellenave *In its* An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Tech. 1 Jan. 1972 58 p refs Original contains color illustrations

Avail: NTIS HC \$6.00/MF \$0.95 CSCL 08H

Investigations are in progress which deal with the applications of remote sensing data in the study of earth resources in southern California. Areas of interest are: (1) inventory of rural land use and monitoring land use change related to Lake Perris; (2) development of models and methodologies for utilizing remotely sensed data; (3) utilization of synoptic photography to develop techniques for urban and regional planning; (4) update of previous NASA study to map vegetation in southern California from color infrared photography; (5) development of methodologies and production of gross land use maps, using computer graphics; and (6) use of remote sensing as a technique for assessing environmental quality as affected by the impact of urbanization in southern California. A.L.

N72-21357* Texas A&M Univ., College Station. Remote Sensing Center.

REMOTE SENSING IN HYDROLOGY: A SURVEY OF APPLICATIONS WITH SELECTED BIBLIOGRAPHY AND ABSTRACTS

Sidney W. Sers, comp. Oct. 1971 30 p refs (Grant NGL-44-001-001)

(NASA-CR-126025; RSC-22) Avail: NTIS CSCL 08H

Remote infrared sensing as a water exploration technique is demonstrated. Various applications are described, demonstrating that infrared sensors can locate aquifers, geothermal water, water trapped by faults, springs and water in desert regions. The potentiality of airborne IR sensors as a water prospecting tool is considered. Also included is a selected bibliography with abstracts concentrating on those publications which will better acquaint the hydrologist with investigations using thermal remote sensors as applied to water exploration. Author

N72-23294 Connecticut Univ., Storrs.

SPACE ACQUIRED DATA: HYDROLOGICAL REQUIREMENTS

Paul Bock *In* Princeton Univ. Proc. of the Princeton Univ. Conf. on Aerospace Methods for Revealing and Evaluating Earth's Resources Jun. 1970 8 p

Copyright. Avail: Issuing Activity

The needs for physical-mathematical models of the large-scale hydrologic cycle and coordinated hydrologic observational networks are described. The applications of space technology to hydrology are identified as basic studies of the hydrologic cycle, snow and ice mapping, surveys of coastal hydrologic features and large inland lakes, and real time communications of ground-based hydrologic data. Several remote sensing techniques were investigated, including panchromatic photography, TV, multispectral point scanning, infrared imagery, and radar imagery. These could provide data on snowpacks, ice and glaciers, water circulation, pollutant dispersions, and underwater detail in coastal waters, estuaries, lakes, and reservoirs. N.E.N.

N72-23298 Earth Satellite Corp., Washington, D.C. Interdisciplinary Applications.

A WATER MANAGEMENT MODEL USING EARTH RESOURCES SATELLITES

Allan H. Muir *In* Princeton Univ. Proc. of the Princeton Univ. Conf. on Aerospace Methods for Revealing and Evaluating Earth's Resources Jun. 1970 15 p

Copyright. Avail: Issuing Activity

A systems analysis study is described that defined a complex and stringent set of requirements for an earth resources information system using satellite-based sensors, developed a concept for a satellite-assisted information system to meet these requirements that appear to be technically feasible for the mid-1970's, and evaluated the costs and benefits of deploying such a satellite system operationally. The analysis was oriented toward the practical application of the information from an operational remote sensing satellite system to critical management decisions that could benefit from repetitive, large-area coverage. The analytical framework was provided by developing a user-decision model, which permitted the information requirements, system concept, and cost-benefit analysis to be generated in cooperation with identified users of a satellite-assisted information system. It is believed that the study demonstrates that (1) substantial benefits can be realized from a satellite system capability, and (2) the methodology is applicable and appropriate for analyzing other major areas of information needs for earth resources management. Author

N72-23323# International Business Machines Corp., Gaithersburg, Md.

REMOTE SENSING AND DATA HANDLING: THEIR APPLICATION TO WATER RESOURCES

Peter A. Castruccio *In* Comm. on Sci. and Astronaut. (U.S. House) Remote Sensing of Earth Resources 1972 p 209-220

Avail: SOD \$1.25

The current techniques employed in watershed management are discussed and the development of models to predict how much water will be available in a watershed as a function of rainfall is examined. It is pointed out that the present methods used for the gathering of these data requires costly instrumentation and are rapidly becoming too expensive from a cost effectiveness standpoint. It is concluded that remote sensing appears to hold the potential for a major step forward in cost performance. The benefits of applying remote sensing techniques to the determination of hydrologic regime of watersheds are considered to be: (1) improvement in predictive accuracy of already instrumented and modeled watersheds; and (2) the determination of the hydrologic regimes of as yet unknown watersheds, with potentially significant reductions in time, labor, and cost over present methods. D.L.G.

N72-23326* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

HYDROLOGY OF THE NIGER RIVER FROM NIMBUS HRIR

Norman MacLeod *In its* Significant Accomplishments in Sci., 1970 1972 p 8-13

Avail: NTIS HC \$3.00 CSCL 08H

The seasonal changes in aspect of the Niger River in the Republic of Mali, West Africa, as seen in daytime imagery

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obtained by the high-resolution infrared radiometer on Nimbus 3 are described. The identification of different plants by their reflectance is shown to provide an ecological map that changes with time. It is concluded that Nimbus imagery provides an integrated view of the entire watershed on a daily basis. F.O.S.

N72-23445# Colorado State Univ., Fort Collins. Dept. of Electrical Engineering.

THE MEASUREMENT OF SNOW DEPTH AND DENSITY USING A SHORT PULSED RADAR SYSTEM Final Report, Jun. - Dec. 1971

Rogers S. Vickers Dec. 1971 34 p refs

(Contract DI-14-06-D-7159-1)

(PB-206685; REC-14-06-D-71591) Avail: NTIS HC \$3.00 CSCI 08L

The measurement of the thickness and water content of snow and ice layers from a remote location has been the object of much research activity over the past decade. In particular, several radar techniques have been applied to the problem with varying degrees of success. A short pulse radar system is described in this report which measures the thickness and water equivalent of snow and ice layers. Representative data from field tests of the system are included, in which it is shown that snow density and thickness can be measured to better than 10% accuracy. Author (GRA)

N72-24404* Wisconsin Univ., Madison. Dept. of Civil Engineering.

AERIAL PHOTOGRAPHY FOR WATER RESOURCES STUDIES

Ralph W. Kiefer and James P. Scherz Aug. 1971 24 p refs Presented at ASCE Natl. Water Resources Eng. Meeting, Phoenix, Ariz., 11-15 Jan. 1971

(Grant NGL-50-002-127)

(NASA-CR-126629; Rept-6) Copyright. Avail: Wis. Univ., Madison, 351 Meteorology and Space Sci. Bldg.: HC \$2.00 CSCI 08H

Airborne remote sensing using the photographic portion or the electromagnetic energy spectrum is considered. Illustrations are presented to show the use of color and color-infrared aerial photography to study siltation and algae growth in lakes, to map aquatic plants in lakes, to detect and monitor water pollution, and to study stream flooding. Author

N72-26290* Geological Survey, Washington, D.C. **HYDROLOGIC INTERPRETATIONS BASED ON INFRARED IMAGERY OF LONG ISLAND, NEW YORK**

Edward J. Pluhowski 1972 24 p refs Sponsored by NASA (NASA-CR-127032; USGS-WSP-2009-B; LC-75-190389) Avail: NTIS; SOD \$0.30 CSCI 08C

Six remote-sensing flights over Long Island's north and south shores were made during the period July 13, 1967, to February 25, 1970. Infrared imagery in the 8- to 14-micrometer range was obtained; results varied from poor to excellent in quality. The ability of the RS 7 and Reconofax 4 imagers to discern thermal contrasts of as little as 1 to 2 C (Celsius) permitted identification of areas of heavy ground-water discharge. These areas were concentrated primarily along the eroded headlands of the north shore and in the lower reaches of watercourses draining into Great South Bay. Only a few highly localized examples of direct ground-water discharge into the embayments along Long Island's south shore were detected in the imagery. Thermal loading emanating from a powerplant near Oceanside is shown to be quickly dissipated in Middle Bay. Optimal time for the collection of infrared imagery for hydrologic studies on Long Island is in summer and in winter, when surface-water thermal differences are relatively large. Author

N72-27660# Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center.

CONVECTIVE HEAT AND MASS TRANSFER FROM WATER SURFACES

J. Taylor Beard, Charles S. Chen, and Chandrika Prasad Nov.

1971 37 p refs Prepared in cooperation with Va. Univ., Charlottesville

(Grant OWRR-B-021-VA(3))

(PB-207638; VPI-WRR-C-Bull-47) Avail: NTIS HC \$3.00 CSCI 04B

Analog computer-methods were used to study convective heat and mass transfer between horizontal flows of air and surface. Solutions of the laminar boundary layer equations for both the gaseous and liquid phases were developed. Profiles of velocity, temperature, and concentration and their gradients were obtained from these solutions. The experimental verification of these results was carried out in a special air-water facility. Concentration of water vapor in air was obtained through the use of a Mach-Zehnder interferometer and the thermocouple-measured temperatures. Analytical and experimental results are in good agreement and indicate a marked influence of the interfacial motion on heat and mass transfer rates. In co-current flow the increase in the interfacial velocity increased the heat and mass removal resulting from the finite velocity of the interface itself and the increased velocities in the boundary layer close to the interface. Author (GRA)

N72-27662# Israel Program for Scientific Translations, Ltd., Jerusalem.

DETERMINATION OF THE WATER EQUIVALENT OF SNOW COVER: METHODS AND EQUIPMENT

L. K. Vershinina, ed. and A. M. Dimakhsyan, ed. 1971 147 p refs Transl. into ENGLISH of the publ. "Issledovaniya metodov, apparatury i tochnosti opredeleniya zapasov vody v snezhnom pokrove" Leningrad, Gidrometeorol., 1969 180 p Sponsored by NOAA and NSF

(TT-70-50093) Avail: NTIS HC \$3.00 CSCI 04B

Methodical and experimental errors of airborne Gamma Surveys are estimated from experimental and theoretical data. Consideration is given to the effect of soil moisture content, snow surface relief and locality off-course aircraft deviations, and hydrographic elements. Data also cover assessment of long term variability in water reserves of the upper soil layer during the autumn-water period, statistical estimates of areas with homogeneous snow cover depth distributions, and principle rules in selecting and charting courses for airborne measurement of snow water equivalent. GRA

N72-28309* American Univ., Washington, D.C.

ERTS-A DATA USER INVESTIGATION OF WETLANDS ECOLOGY Progress Report No. 1

Richard R. Anderson, principal investigator 6 Jul. 1972 2 p Sponsored by NASA

(E72-10001; NASA-CR-127558; GSFC-ID-UN006; PR-1) Avail: NTIS HC \$3.00 CSCI 08H

This report contains no significant results.

Author

N72-28311* Maine Dept. of Transportation, Augusta.

TO MAP THE DISTRIBUTION OF GLACIOFLUVIAL DEPOSITS AND ASSOCIATED GLACIAL LANDFORMS Progress Report

Raymond G. Woodman, principal investigator 1 Jul. 1972 1 p (Contract NAS5-21747)

(E72-10003; NASA-CR-127556; GSFC-ID-ST354; PR-1) Avail: NTIS HC \$3.00 CSCI 08E

This report contains no significant results.

Author

N72-28372# National Oceanic and Atmospheric Administration, Rockville, Md.

INTERNATIONAL FIELD YEAR FOR THE GREAT LAKES

Jan. 1972 41 p

(IFYGL-Bull-1) Avail: NTIS HC \$4.25

A preliminary overview of the present status of the organization and planning for the United States scientific program in the field operations phase of the International Field Year for the Great Lakes (IFYGL) is presented. The basic objective is the development of a sound scientific basis for water resources management as an aid in solving problems of water quality and quantity. G.G.

N72-28397 Montpellier Univ. (France). Centre d'Etude et de Recherches Hydrologiques.

FIRST RESULTS OF A REMOTE SENSING STUDY OF THE LANGUEDOC COAST PONDS [PREMIERS ENSEIGNEMENTS D'UNE ETUDE PAR TELE-DETECTION DES ETANGS COTIERS LANGUEDOCIENS]

G. Armangau *In* CNES Remote Sensing of Earth Resources Oct. 1971 p 377-422 *In* FRENCH Original contains color illustrations

Some remote sensing techniques for vegetation, human activities, and water dynamics studies are presented. They include aerial multispectral photography, Cyclope infrared scanner, and the LHD infrared radiometer. The results obtained using all three methods are compared and discussed. Remote sensors for the investigation of coastal ecology is emphasized. ESRO

N72-29267*# Texas Technological Univ., Lubbock.
DYNAMICS OF PLAYA LAKES IN THE TEXAS HIGH PLAINS

C. C. Reeves, Principal Investigator 30 Jul. 1972 2 p
Sponsored by NASA
(E72-10015; NASA-CR-127494) Avail: NTIS HC \$3.00 CSCL 08H

N72-29268*# Corps of Engineers, Waltham, Mass. New England Div.

ERTS-A DATA USER INVESTIGATION OF THE USE OF ERTS IMAGERY IN RESERVOIR MANAGEMENT AND OPERATION Progress Report, 14 Jun. - 14 Aug. 1972

Saul Cooper, Co-Principal Investigator and Paul Bock, Co-Principal Investigator 11 Aug. 1972 5 p Sponsored by NASA
(E72-10016; NASA-CR-127495) Avail: NTIS HC \$3.00 CSCL 08H

N72-29270*# Vermont Univ., Burlington.
ENVIRONMENTAL STUDY OF ERTS-A IMAGERY LAKE CHAMPLAIN BASIN AND VERMONT Bimonthly Report, 8 Jun. - 1 Aug. 1972

A. O. Lind, Principal Investigator 1 Aug. 1972 2 p
(Contract NAS5-21753)
(E72-10018; NASA-CR-127742; GSFC-ID-UN137) Avail: NTIS HC \$3.00 CSCL 08H

N72-29271*# Earth Satellite Corp., Washington, D.C.
INVESTIGATION TO IMPROVE MENHADEN FISHERY PREDICTION Progress Report, 1 Jun. - 31 Jul. 1972

Paul M. Maughan, Principal Investigator 7 Aug. 1972 2 p
(Contract NAS5-21743)
(E72-10019; NASA-CR-127743; ERTS-1/2) Avail: NTIS HC \$3.00 CSCL 08A

N72-29298# Toronto Univ. (Ontario). Inst. of Environmental Sciences and Engineering.

REMOTE SENSING EVALUATION OF ENVIRONMENTAL FACTORS AFFECTING THE DEVELOPMENTAL CAPACITY OF INLAND LAKES

S. J. Glenn Bird 9 Feb. 1972 20 p ref Presented at 1st Can. Remote Sensing Symp., Ottawa, 9 Feb. 1972
(Rept-1001180) Avail: NTIS HC \$3.00

Multidisciplinary aspects of remote sensing were applied to the developmental capacity of the inland lakes of Ontario. The relationship of aerial photointerpretation and remote sensing techniques to the environment evaluation is discussed. The parameters affecting the recreational land usage were evaluated, including basin physiography, water physical variables, water biological variables, and water chemical variables. J.A.M.

N72-29306* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

NIMBUS HYDROLOGICAL OBSERVATIONS OVER THE WATERSHEDS OF THE NIGER AND INDUS RIVERS

Vincent V. Salomonson and Norman H. MacLeod *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 11 p
Original contains color illustrations

CSCL 08H

As a result of studying the Nimbus imagery over these two watersheds, it is felt that a perspective and understanding of the large scale hydrological processes and their interrelationship has been obtained which could be obtained by no other means in so short a time. In the case of the Niger River a much better appreciation of the flooding process has been obtained along with the role of the Inland Delta in this process. Obviously a knowledge of the spatial and temporal distribution of the snow-melt process in the Indus River watershed is now available that was obtained with minimal effort, as compared to the effort and time that would be required using conventional methods. It seems clear that even the low resolution data easily available from meteorological satellites can be a valuable source of information in the better management of the water resources in these regions. Author

N72-29324* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

SALINITY SURVEYS USING AN AIRBORNE MICROWAVE RADIOMETER

J. F. Paris (Lockheed Electron., Houston, Tex.), J. D. Droppleman (Lockheed Electron., Houston, Tex.), and D. E. Evans *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 27 p refs
CSCL 08H

The Barnes PRT-5 infrared radiometer and L-band channel of the multifrequency microwave radiometer are used to survey the distribution of surface water temperature and salinity. These remote sensors were flown repetitively in November 1971 over the outflow of the Mississippi River into the Gulf of Mexico. Data reduction parameters were determined through the use of flight data obtained over a known water area. With these parameters, the measured infrared and microwave radiances were analyzed in terms of the surface temperature and salinity. Author

N72-29346* Wisconsin Univ., Madison. Inst. for Environmental Studies.

APPLICATION OF REMOTE SENSING TO WATER RESOURCES PROBLEMS

James L. Clapp *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2, 21 Jan. 1972 40 p
Original contains color illustrations

CSCL 08H

The following conclusions were reached concerning the applications of remote sensing to water resources problems: (1) Remote sensing methods provide the most practical method of obtaining data for many water resources problems; (2) the multi-disciplinary approach is essential to the effective application of remote sensing to water resource problems; (3) there is a correlation between the amount of suspended solids in an effluent discharged into a water body and reflected energy; (4) remote sensing provides for more effective and accurate monitoring, discovery and characterization of the mixing zone of effluent discharged into a receiving water body; and (5) it is possible to differentiate between blue and blue-green algae. Author

N72-29348* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

LAND UTILIZATION AND WATER RESOURCE INVENTORIES OVER EXTENDED TEST SITES

Roger M. Hoffer *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 39 p refs Original contains color illustrations

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(Grant NGL-15-005-112)
CSCL 08H

In addition to the work on the corn blight this year, several other analysis tests were completed which resulted in significant findings. These aspects are discussed as follows: (1) field spectral measurements of soil conditions; (2) analysis of extended test site data; this discussion involves three different sets of data analysis sequences; (3) urban land use analysis, for studying water runoff potentials; and (4) thermal data quality study, as an expansion of our water resources studies involving temperature calibration techniques. Author

N72-29364* Bureau of Reclamation, Denver, Colo.
REMOTE SENSING OF WET LANDS IN IRRIGATED AREAS
Herbert H. Ham /in NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 10 p refs
CSCL 08H

The use of airborne remote sensing techniques to: (1) detect drainage problem areas, (2) delineate the problem in terms of areal extent, depth to the water table, and presence of excessive salinity, and (3) evaluate the effectiveness of existing subsurface drainage facilities, is discussed. Experimental results show that remote sensing, as demonstrated in this study and as presently constituted and priced, does not represent a practical alternative as a management tool to presently used visual and conventional photographic methods in the systematic and repetitive detection and delineation of wetlands. Author

N72-29365* Colorado State Univ., Fort Collins.
SHORT PULSE RADAR MEASUREMENTS OF LAYERED ICE AND SNOW
R. S. Vickers and G. C. Rose /in NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 20 p refs
(Contract DL-14-06-D-7159)
CSCL 08L

Using a radar system with high range resolution, it was shown that measurements of snow and ice thickness are feasible with an accuracy of better than 3 inches. In addition, the water equivalent of the snowpack can be estimated, given a single surface measurement of the snow depth. Discontinuities in density were also detected and their location determined by inspection of the radar returns. The remote measurement of layer thickness is described. The system was designed for eventual incorporation into a light aircraft. Author

N72-29373* Geological Survey, Washington, D.C.
WETLANDS DELINEATION BY SPECTRAL SIGNATURE ANALYSIS AND LEGAL IMPLICATIONS
Richard R. Anderson (American Univ., Washington, D. C.) and Virginia Carter /in NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 9 p

CSCL 08H

High altitude analysis of wetland resources and the use of such information in an operational mode to address specific problems of wetland preservation at a state level are discussed. Work efforts were directed toward: (1) developing techniques for using large scale color IR photography in state wetlands mapping program, (2) developing methods for obtaining wetlands ecology information from high altitude photography, (3) developing means by which spectral data can be more accurately analyzed visually, and (4) developing spectral data for automatic mapping of wetlands. E.H.W.

N72-29377* Geological Survey, Tucson, Ariz.
QUANTITATIVE RELATIONSHIP BETWEEN REFLECTANCE AND TRANSPIRATION OF PHREATOPHYTES, GILA RIVER TEST SITE
R. C. Culler, J. E. Jones, and R. N. Turner /in NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 9 p refs

CSCL 08H

The use of IR aerial photographs for determining the dynamic characteristics of evapotranspiration at the Gila River Test Site is discussed. Evapotranspiration was measured as a function of plant volume, surface conditions, soil moisture storage, and ground water levels. E.H.W.

N72-29387* National Oceanic and Atmospheric Administration, Washington, D.C.
COMPARISON OF REMOTE SENSORS FOR SOIL MOISTURE AND OTHER HYDROLOGIC STUDIES
Donald R. Wiesnet /in NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 11 p refs
CSCL 08M

Progress in lake temperature and soil moisture remote sensing during 1971. The use of satellite data and imagery for improved flood and low flow forecasts, improved water level and ice reports for the Great Lakes, and better and faster coastal zone storm damage assessment is considered. Author

N72-29389* National Oceanic and Atmospheric Administration, Washington, D.C.
DETERMINATION OF THAWING SNOW AND ICE SURFACES USING EARTH SATELLITE DATA
Donald R. Wiesnet and David F. McGinnis /in NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 9 p refs

CSCL 08L

The apparent differential spectral reflectance is reported as sensed by the imaging disector camera system in the visible portion of the electromagnetic spectrum and by the high resolution infrared radiometer in the near-IR portion of the electromagnetic spectrum. Both instruments were aboard the Nimbus 3 satellite. Author

N72-29390* Allied Research Associates, Inc., Concord, Mass.
SNOW STUDIES USING THERMAL INFRARED OBSERVATIONS FROM EARTH SATELLITES
James C. Barnes /in NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 7p
CSCL 08L

The application of satellite high resolution infrared data was studied for mapping snow cover. The study has two objectives: (1) to determine whether existing radiometers onboard the Nimbus andITOS satellites can provide hydrologically useful snow information, and (2) to develop analysis techniques applicable to future IR sensor systems on earth satellites. The IR measurements are being analyzed in conjunction with concurrent satellite photographs and conventional snow cover data. Author

N72-29404* Naval Research Lab., Washington, D.C.
A STUDY OF TEMPORAL ESTUARINE FLOW DYNAMICS
Robert L. Mairs and Dennis K. Clark (Naval Oceanographic Office) /in NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 19 p refs
Original contains color illustrations.

CSCL 08H

Multispectral photography, infrared imagery, image enhancement, and oceanographic, radiometric, and meteorological data were used in the study of temporal estuarine flow dynamics, nearshore circulation, and the resulting dispersal of suspended and dissolved substances introduced from the continent. Repetitive multispectral photography, IR imagery, total radiance and irradiance, water surface temperatures, salinity, total suspended solids, visibility, current velocity, winds, dye implants, and high contrast image enhancement were used to observe and describe water mass boundaries in the nearshore zone and to attempt to establish on what repetitive scale these coastal features should be observed to better understand their behavior. Water mass variability patterns, seen naturally and with the use

06 HYDROLOGY AND WATER MANAGEMENT

of dyes, along the North Carolina coast and in the Chesapeake Bay are being studied as synoptic data on the basic dynamics of circulation, flushing, and mixing in coastal waters. Author

N72-29411* Agricultural Research Service, Chickasha, Okla. Southern Plains Branch.

MEASUREMENTS FROM AIRCRAFT TO CHARACTERIZE WATERSHEDS

Bruce J. Blanchard *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 14 p. refs

CSCS 08H

Remote sensor measurements of the Southern Plains watershed, an 1130 sq mile segment of the Washita River basin in the Texas Panhandle, are discussed. Soil moisture measurements are emphasized, along with rainfall storage capacity of the soil. Indicators of pond water quality, geologic sources of sediment or salt, and rapid methods of mapping seepage are being searched for through remote sensing. J.A.M.

N72-30310*# Wolf Research and Development Corp., Riverdale, Md.

THE INTERDEPENDENCE OF LAKE ICE AND CLIMATE IN CENTRAL NORTH AMERICA Progress Report

Allan Jelacic, Principal Investigator 4 Aug. 1972 2 p (Contract NAS5-21761)

(E72-10030; NASA-CR-127895) Avail: NTIS HC \$3.00 CSCL 08L

N72-30311*# National Environmental Satellite Service, Washington, D.C.

EVALUATION OF ERTS DATA FOR CERTAIN HYDROLOGICAL USES Phase 1 Report, Jun. - Jul. 1972

Donald R. Wiesnet, Principal Investigator and David F. McGinnis Jul. 1972 4 p Sponsored by NASA

(E72-10031; NASA-CR-127896) Avail: NTIS HC \$3.00 CSCL 08H

N72-30313*# Texas Technological Univ., Lubbock.

DYNAMICS OF PLAYA LAKES IN THE TEXAS HIGH PLAINS

C. C. Reeves, Jr., Principal Investigator 18 Jul. 1972 4 p Sponsored by NASA

(E72-10033; NASA-CR-127898) Avail: NTIS HC \$3.00 CSCL 08H

N72-30328 National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

MAN'S EFFECTS ON THE ESTUARINE ENVIRONMENT

Leo F. Childs *In* Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 172

Color slides taken over a number of years were used to illustrate the effects of industrialization and the encroachment of over population on the estuarine environment in the Gulf of Mexico. Photography from the Gemini, Apollo, and aircraft program were included. Author

N72-30350# Coastal Plains Center for Marine Development Services, Wilmington, N.C.

AN ENVIRONMENTAL INVENTORY FOR THE COASTAL PLAIN AND ADJACENT ATLANTIC WATERS OF THE SOUTHEASTERN STATES. PART 3: AN INDEX TO HYDROGRAPHIC SURVEYS FOR COASTAL AND INSHORE WATERS OF THE CAROLINAS AND GEORGIA

1972 75 p

(Publ-72-6-Pt-3) Avail: NTIS HC \$5.75

A single source index of the hydrographic data collected for the coastal and inshore waters of the southeastern states is presented. The data is presented in the form of maps and show the surveys conducted during the period 1847 to 1969. The maps and charts are compiled and updated using aerial photographs and field surveys as a basis. Author

N72-31344*# Army Cold Regions Research and Engineering Lab., Hanover, N.H.

DELINEATION OF PERMAFROST BOUNDARIES AND HYDROLOGIC RELATIONSHIPS

Duwayne M. Anderson, Principal Investigator 29 Sep. 1972 4 p Presented as Preliminary Findings from Analyses of ERTS Observations, NASA Goddard Space Flight Center, Greenbelt, Md., 29 Sep. 1972

(NASA Order S-70253AG)

(E72-10053; NASA-CR-128055) Avail: NTIS HC \$3.00 CSCL 08G

N72-31347*# National Oceanic and Atmospheric Administration, Washington, D.C.

DETECTION OF SNOW CONDITIONS IN MOUNTAINOUS TERRAIN

Donald R. Wiesnet, Principal Investigator 29 Sep. 1972 2 p Presented as Preliminary Findings from Analyses of ERTS Observations, NASA Goddard Space Flight Center, Greenbelt, Md., 29 Sep. 1972

(NASA Order S-70246AG)

(E72-10056; NASA-CR-128058) Avail: NTIS HC \$3.00 CSCL 08L

N72-31348*# National Oceanic and Atmospheric Administration, Washington, D.C.

DETECTION OF CIRCULATION FEATURES IN THE GREAT LAKES

Alan E. Strong, Principal Investigator 29 Sep. 1972 1 p Presented as Preliminary Findings from Analyses of ERTS Observations, NASA Goddard Space Flight Center, Greenbelt, Md., 29 Sep. 1972

(NASA Order S-70246AG)

(E72-10057; NASA-CR-128059) Avail: NTIS HC \$3.00 CSCL 08H

N72-31359*# Maine Dept. of Transportation, Augusta.

TO MAP THE DISTRIBUTION OF GLACIOFLUVIAL DEPOSITS AND ASSOCIATED GLACIAL LANDFORMS Progress Report, period ending 1 Sep. 1972

Raymond G. Woodman, Principal Investigator 1 Sep. 1972 2 p Sponsored by NASA

(E72-10077; NASA-CR-128092; PR-2) Avail: NTIS HC \$3.00 CSCL 08B

N72-32349*# Geological Survey, Baltimore, Md.

INVESTIGATION OF BASIN CHARACTERISTICS EXTRACTED FROM ERTS DATA FOR IMPROVING REGRESSION ESTIMATES OF STREAMFLOW Progress Report, 1 Jul. - 31 Aug. 1972

Este F. Hollyday, Principal Investigator 1 Sep. 1972 3 p Sponsored by NASA

(E72-10096; NASA-CR-128145) Avail: NTIS HC \$3.00 CSCL 08H

There are no author-identified significant results in this report.

06 HYDROLOGY AND WATER MANAGEMENT

N72-32358*# Geological Survey, Tacoma, Wash.
EVALUATE ERTS IMAGERY FOR MAPPING AND DETECTION OF CHANGES OF SNOWCOVER ON LAND AND ON GLACIERS Progress Report, 1 Jul. - 31 Aug. 1972
Mark F. Meier, Principal Investigator 15 Aug. 1972 3 p
Sponsored by NASA
(E72-10103; NASA-CR-128152) Avail: NTIS HC \$3.00 CSCL 08L

N72-32359*# Geological Survey, Harrisburg, Pa.
NEAR REAL TIME WATER RESOURCES DATA FOR RIVER BASIN MANAGEMENT Progress Report, 1 Jul. - 31 Aug. 1972
Richard W. Paulson, Principal Investigator 7 Sep. 1972 5 p
Sponsored by NASA
(E72-10107; NASA-CR-128156) Avail: NTIS HC \$3.00 CSCL 08H

N72-32362*# Geological Survey, Arlington, Va.
DYNAMICS OF SUSPENDED SEDIMENT PLUMES IN LAKE ONTARIO Progress Report, 1 Jul. - 31 Aug. 1972
Edward J. Pluhowski, Principal Investigator 1 Sep. 1972 2 p
Sponsored by NASA
(E72-10110; NASA-CR-128158) Avail: NTIS HC \$3.00 CSCL 08J

N72-32364*# Geological Survey, Lakewood, Colo.
DETERMINE THE UTILITY OF ERTS-1 IMAGERY IN THE PREPARATION OF HYDROLOGIC ATLASES OF ARID LAND WATERSHEDS Progress Report, 1 Jul. - 31 Aug. 1972
Lynn M. Shown, Principal Investigator 1 Sep. 1972 2 p
Sponsored by NASA
(E72-10113; NASA-CR-128162) Avail: NTIS HC \$3.00 CSCL 08H

N72-32371*# Wolf Research and Development Corp., Riverdale, Md.
THE INTERDEPENDENCE OF LAKE ICE AND CLIMATE IN CENTRAL NORTH AMERICA Progress Report
Allan Jelacic, Principal Investigator 4 Oct. 1972 7 p
(Contract NAS5-21761)
(E72-10121; NASA-CR-128170) Avail: NTIS HC \$3.00 CSCL 08L

N72-32373*# Kansas Univ., Lawrence. Space Technology Labs.
MONITORING FRESH WATER RESOURCES Bimonthly Progress Report, period ending 30 Sep. 1972
Harold L. Yarger, Principal Investigator 30 Sep. 1972 22 p
refs Sponsored by NASA
(E72-10123; NASA-CR-128177) Avail: NTIS HC \$3.25 CSCL 08H

The author has identified the following significant results. ERTS-1 imagery is promising to be very useful for studying reservoir turbidity patterns. Initial coverage indicates a strong qualitative correlation between film density and turbidity. With repeated coverage and sampling the possibility of developing a reliable quantitative correlation looks good. The question of distinguishing between organic and inorganic suspended loads in Kansas reservoirs is open, but will require considerable more work to answer.

N72-32383*# Alaska Univ., College. Inst. of Water Resources.
BREAK-UP CHARACTERISTICS OF CHENA RIVER BASIN Bimonthly Progress Report
Robert F. Carlson, Principal Investigator 30 Sep. 1972 3 p
Sponsored by NASA
(E72-10135; NASA-CR-128189; BMPR-1) Avail: NTIS HC \$3.00 CSCL 08L

N72-32384*# Alaska Univ., College.
SURVEY OF THE SEASONAL SNOW COVER OF ALASKA Bimonthly Progress Report
Gunter E. Weller, Principal Investigator 30 Sep. 1972 2 p
Sponsored by NASA
(E72-10136; NASA-CR-128190; BMPR-1) Avail: NTIS HC \$3.00 CSCL 08L

N72-32406*# Kanner (Leo) Associates, Redwood City, Calif.
USE OF INFRARED AERIAL PHOTOGRAPHY IN DETECTING AREAS WITH EXCESS SURFACE WATER AND GROUND WATER OUTFLOWS
B. V. Shilin, N. A. Gusev, and Ye. Ya. Karizhenskiy Washington NASA Jun. 1972 12 p refs Transl. into ENGLISH from Sov. Geol. (Moscow), no. 1, 1971 p 155-160
(NASA-TT-F-14481) Avail: NTIS HC \$3.00 CSCL 08H
Applications of aerial photography to hydrogeological studies are considered. The advantages of using infrared aerial photography are also discussed. K.P.D.

N72-33307*# Purdue Univ., Lafayette, Ind.
A STUDY OF THE UTILIZATION OF ERTS-A DATA FROM THE WABASH RIVER BASIN Bimonthly Progress Report
David A. Landgrebe, Principal Investigator 31 Aug. 1972 4 p
(Contract NAS5-21773)
(E72-10149; NASA-CR-128285) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. Preliminary results from the Texoma frame of data indicate many potentials in the analysis and interpretation of ERTS-1 data. It is believed that one of the more significant aspects of this analysis sequence has been the investigation of a technique to relate ERTS analysis and surface observation analysis. At present a sequence involving (1) preliminary analysis based solely upon the spectral characteristics of the data, followed by (2) a surface observation mission to obtain visual information and oblique color photography of particular points of interest in the test site area, appears to provide an extremely efficient technique for obtaining particularly meaningful surface observation data. Following such a procedure allows concentration on particular points of interest in the entire ERTS frame and thereby making the surface observation data obtained to be particularly significant and meaningful. The analysis of the Texoma frame has also been significant from the standpoint of demonstrating a fast turn around analysis capability. Additionally, the analysis has shown the potential accuracy and degree of complexity of features that can be identified and mapped using ERTS-1 data.

N72-33315*# Texas Technological Univ., Lubbock. Dept. of Geosciences.
DYNAMICS OF PLAYA LAKES IN THE TEXAS HIGH PLAINS Progress Report, Apr. - Sep. 1972
C. C. Reeves, Jr., Principal Investigator Oct. 1972 21 p
Original contains illustrations. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
(Contract NAS5-21720)
(E72-10158; NASA-CR-128309) Avail: NTIS \$3.25 CSCL 08H

The author has identified the following significant results. Three small playa lake basins on the southern High Plains, Texas, have been examined by geologists, pedologists,

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hydrologists, and botanists to establish ground truth for correlation with ERTS-1 imagery. Although the sites are recognizable, details of the three plays basins are too small, at present resolution, to be accurately determined by the available MSS imagery. However, a fourth study site, consisting of a dual plays complex approximately 5 miles long in a basin of 9 square miles, does resolve available imagery allowing accurate measurement of water fluctuations and water depth. Of the available MSS imagery, Band 5 is the most usable. Definition of Band 4 is less due to reduced tonal contrast. The greatest tonal contrast appears on Band 6 and Band 7 between dry land and water areas. Band 6 is particularly good for defining large water areas, Band 7 being best for small lake basins, and Band 5 for growing fields.

N72-33323* Corps of Engineers, Waltham, Mass.
THE USE OF ERTS IMAGERY IN RESERVOIR MANAGEMENT AND OPERATION Progress Report, 14 Aug. - 14 Oct. 1972
Saul Cooper, Principal Investigator and Paul Bock 26 Oct. 1972 5 p Sponsored by NASA
(E72-10186; NASA-CR-128350) Avail: NTIS HC \$3.00 CSCL 08H

N72-33365* East Tennessee State Univ., Johnson City.
DELINEATION OF INFORMATION REQUIREMENTS OF THE TVA WITH RESPECT TO REMOTE SENSING DATA Final Report
John B. Rehder Dec. 1971 21 p refs
(PB-210114; USGS-DO-72-005; USGS-IR-235) Avail: NTIS HC \$3.00 CSCL 13B

The information needs and interests of TVA that can be supplied by hyper-altitude imagery and future ERTS-A satellite imagery were determined by interviews. Two series of interviews were used to obtain specific data requirements as they pertain to the kinds of information expected and were particularly keyed to the topics of information needed, the variation of scales and coverage involved between aircraft and satellite platforms, and temporal considerations. Author (GRA)

N72-33371* East Tennessee State Univ., Johnson City.
A MODEL FOR PHOTOMORPHIC ANALYSIS, TENNESSEE VALLEY TEST SITE Final Report
Donald D. MacPhail and Yuk Lee Feb. 1972 37 p refs
Sponsored by Geol. Survey
(PB-209683; USGS-DO-72-006; IR-USGS-236) Avail: NTIS HC \$3.00 CSCL 08F

In order to determine the utility of the photomorphic concept of landscape analysis to the TVA for use in regional planning, a model for analysis is necessary. The methodology and sampling techniques to be used in conjunction with a demonstration project using the photomorphic concept include: identifying photomorphic patterns on black and white, intermediate-scale imagery; reducing these data to base map scale; selecting sample areas; and quantitatively measuring and testing the physical and cultural features such as drainage density, soil moisture, mean farm size, percent of vegetation cover, and population density to determine the validity of the photomorphic mapping. Author (GRA)

N73-10361* National Environmental Satellite Service, Washington, D.C.
EVALUATION OF ERTS DATA FOR CERTAIN HYDROLOGICAL USES Phase Report, Aug. - Sep. 1972
Donald R. Wiesnet, Principal Investigator and David F. McGinnis Sep. 1972 4 p Sponsored by NASA
(E72-10170; NASA-CR-128361) Avail: NTIS HC \$3.00 CSCL 08H

N73-10366* Stanford Research Inst., Calif.
STUDY OF TIME LAPSE DATA PROCESSING FOR DYNAMIC HYDROLOGIC CONDITIONS Progress Report, 6 Sep. - 6 Nov. 1972

Sidney M. Serebreny, Principal Investigator 6 Nov. 1972 8 p
(Contract NAS5-21841)
(E72-10187; NASA-CR-128385) Avail: NTIS HC \$3.00 CSCL 08H

N73-10426* Puerto Rico Univ., Mayaguez. Water Resources Research Inst.
SUBMARINE SPRING EXPLORATIONS: NORTHWEST COAST OF PUERTO RICO Final Report
Donald J. Percious Nov. 1971 54 p refs
(PB-210754; UPRICO-WRRI-FR-71-29-1; W72-10896; OWRR-A-029-PR(1)) Avail: NTIS HC \$3.00 CSCL 08H

In an attempt to delineate areas of ocean groundwater discharge along the northwestern coastal area of Puerto Rico, a series of aerial photographic missions and near-coastal conductivity traverses were made. It was also an objective of the photographic missions to establish that the use of small format (35 mm) photography, using Ektachrome Infrared and Ektachrome X film, is a fruitful approach to water resources investigations for small agencies. Three spring areas were found using a trailing specific conductivity probe from the Institute's 34 foot research vessel. Author (GRA)

N73-11299* Environmental Research and Technology, Inc., Lexington, Mass.
EVALUATE THE APPLICATION OF ERTS-A DATA FOR DETECTING AND MAPPING SNOW COVER Bimonthly Progress Report, 31 Aug. - 31 Oct. 1972
James C. Barnes, Principal Investigator 10 Nov. 1972 8 p
(Contract NAS5-21803)
(E72-10202; NASA-CR-129068; ERT-P-407-2; BMPR-2) Avail: NTIS HC \$3.00 CSCL 08L

The author has identified the following significant results. Preliminary results of the analysis of a limited sample of ERTS-1 data from the western United States and the Arctic indicate that snow cover can be detected in the MSS-4 and MSS-5 bands by its high reflectance compared to that of the surrounding snow-free terrain. Snow can generally be distinguished from clouds because of well-defined boundaries as compared with the less distinct cloud edges, the lack of shadows characteristic of clouds, and pattern configurations that fit closely with higher elevations and terrain features. At higher latitudes where repetitive ERTS-1 coverage occurs snow can also be identified by the day-to-day continuity of the patterns. In the longer wavelengths, particularly the MSS-7 band, the contrast between snow and snow-free terrain is much lower, and, thus, snow is more difficult to detect. ERTS-1 data from the Canadian Arctic shows the seasonal increase in snow cover in several areas. In other ERTS-1 data, considerable detail is evident in glaciers located along the east and west coasts of Greenland. A.L.

N73-11310* Corps of Engineers, Champaign, Ill.
EFFECTS OF CONSTRUCTION AND STAGED FILLING OF RESERVOIRS ON THE ENVIRONMENT AND ECOLOGY Progress Report, 9 Aug. - 8 Oct. 1972
R. K. Jain, Principal Investigator 8 Oct. 1972 1 p Sponsored by NASA
(E72-10216; NASA-CR-128487) Avail: NTIS HC \$3.00 CSCL 08H

N73-11311* Corps of Engineers, Champaign, Ill.
EFFECT OF CONSTRUCTION AND STAGED FILLING OF RESERVOIRS ON THE ENVIRONMENT AND ECOLOGY Progress Report, 8 Jun. - 8 Aug. 1972
R. K. Jain, Principal Investigator 8 Aug. 1972 1 p Sponsored by NASA
(E72-10217; NASA-CR-128488) Avail: NTIS HC \$3.00 CSCL 08H

N73-11323* Water Survey of Canada, Ottawa, (Ontario).
WATER SURVEY OF CANADA: APPLICATION FOR USE OF ERTS-A FOR RETRANSMISSION OF WATER RESOURCES DATA Progress Report
R. A. Halliday, Principal Investigator 17 Nov. 1972 10 p

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Sponsored by NASA. Original contains color illustrations
(E72-10230; NASA-CR-129094; PR-1) Avail: NTIS HC
\$3.00 CSCL 08H

N73-11409*# Amerind Publishing Co. Pvt. Ltd., New Delhi
(India).

DECIPHERING OF GROUNDWATER FROM AERIAL PHOTOGRAPHS

K. E. Nefedov and T. A. Popova 1972 201 p refs Transl.
into ENGLISH of the publ. "Deshifri rovanie gruntovykh vod po
aerofotosnimkam" Leningrad, Gidrometeorol., 1969 Sponsored
by NASA and NSF
(NASA-TT-F-681; TT-71-58005) Avail: NTIS HC \$3.00 CSCL
14E

The use of aerial photographs in groundwater studies is
discussed. The principles of groundwater photointerpretation, aerial
photo sampling, and extrapolation of aerial photo indexes are
described. The technique is given for the medium-scale mapping
of groundwater in areas of deficient precipitation. Various
landscape elements and morphological units are considered in
terms of the estimation of groundwater conditions. Author

N73-12330*# Bendix Corp., Ann Arbor, Mich.
**UTILIZATION OF ERTS-1 DATA TO MONITOR AND
CLASSIFY EUTROPHICATION OF INLAND LAKES** Bi-
monthly Progress Report, 1 Aug. - 1 Oct. 1972
Philip E. Chase, Principal Investigator 1 Oct. 1972 3 p
(Contract NAS5-21810)
(E72-10207; NASA-CR-129189) Avail: NTIS HC \$3.00 CSCL
08H

N73-12331*# Purdue Univ., Lafayette, Ind. Lab. for Application
of Remote Sensing.

A STUDY OF THE UTILIZATION OF ERTS-A DATA FROM THE WABASH RIVER BASIN. AN EARLY ANALYSIS OF ERTS-1 DATA Bimonthly Progress Report, 1 Sep. - 31 Oct. 1972

D. A. Landgrebe, R. M. Hoffer, Principal Investigators, and F. E.
Goodrick 31 Oct. 1972 29 p Original contains imagery. Original
photography may be purchased from the EROS Data Center,
10th and Dakota Avenue, Sioux Falls, S. D. 57198
(Contract NAS5-21773)
(E72-10208; NASA-CR-128479; LARS-092972) Avail: NTIS
HC \$3.50 CSCL 08H

The author has identified the following significant results. A
classification of a portion of frame E-1016-16050 CCT was
completed using the LARSYS software. The categories: row crops
(corn or soybeans), forest and woodland areas, diverted acres of
pastureland or nonproductive grassland areas, water (rivers),
clouds, and cloud shadows, were represented by one or more
spectral classes. The results of this classification are significant
in that they show potential for accurate identification and
delineation of forested and agricultural areas using automatic
data handling techniques.

N73-12333*# Vermont Univ., Burlington. Dept. of Geography.
**ENVIRONMENTAL STUDY OF ERTS-1 IMAGERY LAKE
CHAMPLAIN AND VERMONT**

A. O. Lind, Principal Investigator 6 Dec. 1972 3 p

(Contract NAS5-21753)

(E72-10225; NASA-CR-129158) Avail: NTIS HC \$3.00 CSCL
08M

N73-12337*# Geological Survey, Tacoma, Wash.

EVALUATE ERTS IMAGERY FOR MAPPING AND DETEC- TION OF CHANGES OF SNOWCOVER ON LAND AND ON GLACIERS Progress Report, 1 Sep. - 31 Oct. 1972

Mark F. Meier, Principal Investigator 24 Oct. 1972 4 p

Sponsored by NASA

(E72-10237; NASA-CR-129114) Avail: NTIS HC \$3.00 CSCL
08L

The author has identified the following significant results.
Preliminary results on the feasibility of mapping snow cover
extent have been obtained from a limited number of ERTS-1
images of mountains in Alaska, British Columbia, and Washington.
The snowline on land can be readily distinguished, except in
heavy forest where such distinction appears to be virtually
impossible. The snowline on very large glaciers can also be
distinguished remarkably easily, leading to a convenient way to
measure glacier accumulation area ratios or equilibrium line
altitude. Monitoring of large surging glaciers appears to be
possible, but only through observation of a change in area and/or
medial moraine extent. Under certain conditions, ERTS-1 imagery
appears to have high potential for mapping snow cover in
mountainous areas. Distinction between snow and clouds appears
to require use of the human eye, but in a cloud-free scene the
snow cover is sufficiently distinct to allow use of automated
techniques. This technique may prove very useful as an aid in
the monitoring of the snowpack water resource and the prediction
of summer snowmelt runoff volume.

N73-12338*# Bureau of Reclamation, Denver, Colo.

APPLICATION OF REMOTE SENSING TO SELECTED BUREAU OF RECLAMATION PROJECTS Progress Report, 1 Sep. - 31 Oct. 1972

Larry D. Cast, Principal Investigator 31 Oct. 1972 2 p

Sponsored by NASA

(E72-10238; NASA-CR-129115) Avail: NTIS HC \$3.00 CSCL
08G

N73-12339*# Geological Survey, Harrisburg, Pa.

NEAR REAL TIME WATER RESOURCES DATA FOR RIVER BASIN MANAGEMENT Progress Report, 1 Sep. - 31 Oct. 1972

Richard W. Paulson, Principal Investigator 31 Oct. 1972 5 p

Sponsored by NASA

(E72-10239; NASA-CR-129116) Avail: NTIS HC \$3.00 CSCL
08H

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N73-12340* Geological Survey, Lakewood, Colo.
DETERMINE THE UTILITY OF ERTS-1 IMAGERY IN THE PREPARATION OF HYDROLOGIC ATLASES OF ARID LAND WATERSHEDS Progress Report, 1 Sep. - 31 Oct. 1972
 Lynn M. Shown, Principal Investigator 1 Nov. 1972 2 p
 Sponsored by NASA
 (E72-10240; NASA-CR-129117) Avail: NTIS HC \$3.00 CSCL 08H

N73-12352* Vermont Univ., Burlington.
ERTS-1 IMAGERY OF THE LAKE CHAMPLAIN REGION: A FIRST LOOK
 A. O. Lind, Principal Investigator, E. B. Henson, J. Olson, and W. P. Wagner Oct. 1972 7 p
 (Contract NAS5-25176)
 (E72-10252; NASA-CR-129129) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. First-look analysis of RBV imagery of Lake Champlain and adjacent areas provided the following information on land and water resources: (1) location and shape of islands over 200 meters at narrowest part; (2) location of manmade structures at least 10 meters across; (3) location of shoreline; (4) identification of algal blooms and major turbidity boundary; (5) identification of lake bottom features in sandy, shallow areas; (6) identification of major lake shore wetland and floodplain wetlands; (7) location of major streams; (8) identification of ice marginal deposits of major proportions and former shorelines of Champlain Sea; (9) identification of wooded areas, open land, and built-up areas.

N73-12357* Texas Technological Univ., Lubbock. Dept. of Geosciences.
DYNAMICS OF PLAYA LAKES IN THE TEXAS HIGH PLAINS Progress Report
 C. C. Reeves, Jr., Principal Investigator 30 Nov. 1972 5 p
 Sponsored by NASA
 (E72-10257; NASA-CR-128478) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. Regional viewing of ERTS-1 imagery around the test sites shows that storm paths can be accurately traced and a count made of the number of intermittent lake basins filled by the storm. Therefore, during wet years ERTS-type imagery can be used to conduct a reliable count of the tens of thousands of natural lake basins on the southern High Plains which contain water. This type of regional overview of water filled basins in the normally arid southern High Plains is illustrated by bands 6 and 7, ERTS E-1078-16524.

N73-12365* Army Coastal Engineering Research Center, Washington, D.C.
ESTUARY AND BARRIER ISLAND STUDY Progress Report, Sep. - Oct. 1972
 Dennis W. Berg, Principal Investigator and Richard O. Bruno Oct. 1972 1 p
 (NASA Order S-70260-AG)
 (E72-10266; NASA-CR-129228) Avail: NTIS HC \$3.00 CSCL 08H

N73-12380* Vermont Univ., Burlington.
ENVIRONMENTAL STUDY OF ERTS-1 IMAGERY LAKE CHAMPLAIN BASIN AND VERMONT Progress Report, Jun. - Nov. 1972
 A. O. Lind, Principal Investigator 1 Dec. 1972 13 p
 (Contract NAS5-21753)
 (E72-10282; NASA-CR-129254) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. A first approximation land-type map using three categories of classification was generated for the Burlington area. The identification and mapping of a major turbidity front separating turbid waters of the southern arm of Lake Champlain from the clearer main water mass was reported on RBV 1 and 2 imagery and on subsequent MSS bands 4 and 5. Significant industrial pollution of Lake Champlain has degraded environmental quality in certain sections of the lake. Wetlands were detected and recognized using a combination of RBV bands 2 and 3. Using first-look RBV band 2 imagery, major ice marginal features were identified by using tonal patterns associated with vegetative cover. Major rivers were detected and recognized through the use of RBV band 3 imagery and MSS bands 6 and 7.

N73-12407 Reading Univ. (England).
HYDROLOGICAL APPLICATIONS OF SIDE-LOOKING RADAR
 J. R. Hardy /n Elliott-Automation Space and Advan. Mil. Systems Side-looking Radar Systems and their potential Appl. To Earth Resource Surveys, Vol. 3 Aug. 1972 p 85-104 refs

The various hydrological parameters to which SLR imagery may be able to make contributions are outlined. These include precipitation, soil moisture, ground water, water loss, and water quality. Experimental work and potential applications of SLR in hydrology are discussed, including snow coverage, ice studies, and water inventory. Recommendations for an experimental program are given. Author (ESRO)

N73-13350* Maine Dept. of Transportation, Augusta. Bureau of Highways.
MAP THE DISTRIBUTION OF GLACIOFLUVIAL DEPOSITS AND ASSOCIATED GLACIAL LANDFORMS Interim Report, May - Nov. 1972
 Raymond G. Woodman and Ernest G. Stoeckeler, Principal Investigators 30 Nov. 1972 9 p refs
 (Contracts NAS5-21747; NAS5-21772)
 (E72-10300; NASA-CR-129549; Rept-1) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. Relatively little good usable ERTS-1 imagery has been received to date for data extraction. Of three U-2 aircraft support missions flown in Maine, only photography from the 20 September flight is cloud free and of excellent quality. Controlled local contract photography flown in August and September is of generally excellent quality. Low altitude ground truth photography is useful. The system of image and photo filing is discussed, and the limited work involving image and photo comparison is described.

N73-13370* Army Cold Regions Research and Engineering Lab., Hanover, N.H.
THE USE OF ERTS-1 IMAGERY IN THE NATIONAL PROGRAM FOR THE INSPECTION OF DAMS
 Duwayne M. Anderson, Principal Investigator 20 Dec. 1972 1 p Proposed for presentation at Remote Sensing of Water Resources Intern. Symp., Burlington, Ontario, 11-14 Jun. 1973
 (NASA Order S-70253-AG)
 (E72-10322; NASA-CR-129580) Avail: NTIS HC \$3.00 CSCL 08H

06 HYDROLOGY AND WATER MANAGEMENT

N73-13378* Wisconsin Univ., Madison. Inst. for Environmental Studies.

ON MULTIDISCIPLINARY RESEARCH ON THE APPLICATION OF REMOTE SENSING TO WATER RESOURCES PROBLEMS Progress Report, 1971 - 1972

1972 86 p refs

(Grant NGL-50-002-127)

(NASA-CR-129797) Avail: NTIS HC \$6.50 CSCL 08H

This research is directed toward development of a practical, operational remote sensing water quality monitoring system. To accomplish this, five fundamental aspects of the problem have been under investigation during the past three years. These are: (1) development of practical and economical methods of obtaining, handling and analyzing remote sensing data; (2) determination of the correlation between remote sensed imagery and actual water quality parameters; (3) determination of the optimum technique for monitoring specific water pollution parameters and for evaluating the reliability with which this can be accomplished; (4) determination of the extent of masking due to depth of penetration, bottom effects, film development effects, and angle falloff, and development of techniques to eliminate or minimize them; and (5) development of operational procedures which might be employed by a municipal, state or federal agency for the application of remote sensing to water quality monitoring, including space-generated data. Author

N73-13839* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

APPLICATIONS OF REMOTE SENSING TO STREAM DISCHARGE PREDICTIONS c13

Fritz R. Krause and C. Byron Winn (Colo. State Univ.) *In its Space for Mankind's Benefit* 1972 p 109-119 refs

CSCL 05H

A feasibility study has been initiated on the use of remote earth observations for augmenting stream discharge prediction for the design and/or operation of major reservoir systems, pumping systems and irrigation systems. The near-term objectives are the interpolation of sparsely instrumented precipitation surveillance networks and the direct measurement of water loss by evaporation. The first steps of the study covered a survey of existing reservoir systems, stream discharge prediction methods, gage networks and the development of a self-adaptive variation of the Kentucky Watershed model, SNOFSET, that includes snowmelt. As a result of these studies, a special three channel scanner is being built for a small aircraft, which should provide snow, temperature and water vapor maps for the spatial and temporal interpolation of stream gages. Author

N73-13846* Colorado State Univ., Fort Collins.

RIVERBED FORMATION c13

Morris Skinner *In NASA. Marshall Space Flight Center Space for Mankind's Benefit* 1972 p 199-210 refs Original contains color illustrations

The general fluvial processes that work to form a riverbed and produce the characteristic pattern of either meandering, braided, or straight are reviewed. A method for quantification of river pattern and correlation, with the basic hydraulic characteristics of discharge and slope, is presented. Additional characteristics of a river system may be deduced from high-quality photography and imagery obtained from either aircraft or space platforms. Author

N73-14319* Delaware Univ., Newark. Coll. of Marine Studies. DYNAMICS OF PLANKTON POPULATIONS IN UPWELLING AREAS Interim Report, Nov. - Dec. 1972

Karl-Heinz Szekiela, Principal Investigator Dec. 1972 12 p refs

(Contract NAS5-21784)

(E72-10331; NASA-CR-129645) Avail: NTIS HC \$3.00 CSCL 08A

There are no author-identified significant results in this report. Repeated coverage over the test site along the northwest coast of Africa showed that the structure of chlorophyll distribution is much more complicated than expected from continuous recordings. ERTS-1 data showed a very fast change in the chlorophyll distribution and it seems that also the concentration changes quickly. ERTS-1 showed on some frames offshore transportation of dust from the Sahara. All frames from Channel 7 will be arranged as a montage to derive the transportation pattern of dust. This step is important in biological aspects of interpreting ERTS-1 data, because the dissolution kinetics of eolian dust particles may influence significantly the chemistry of the surface water. Since visibility and the biochemistry of the test site off Africa are influenced by the dust transport, dust collection will be included in the ground truth program. Besides chlorophyll and other hydrographical parameters, the dust load in the test area will be measured. The collection plan is discussed along with a description of the high volume air sampler and the Anderson particle sizing head sampler to be used for the dust measurements. A.L.

N73-14332* Alaska Univ., College.

SURVEY OF THE SEASONAL SNOW COVER OF ALASKA Bimonthly Progress Report

Gunter E. Weller, Principal Investigator 13 Dec. 1972 3 p

(Contract NAS5-21833)

(E72-10344; NASA-CR-129658; BMPR-2) Avail: NTIS HC \$3.00 CSCL 08L

The author has identified the following significant results. The delineation of the transient snow cover can generally be made directly from any of the RBV of MSS images. On many glaciers, however, there seems to be a relatively small difference between the reflectivities of snow and ice in the visible portion of the spectrum (corresponding to MSS bands 4 and 5). On the other hand, the reflectivity is distinctly lower for ice than for snow in the near infrared (MSS bands 6 and 7). By applying the sensors of the latter spectral bands the position of the transient snowline, indicative of the mass balance, can in many cases be determined with what appears to be a satisfactory accuracy. This circumstance should prove especially useful in studies of regional variations of glacier mass balances. It had been found that the effect of winds early in the fall seasons can be seen on the arctic slope when a light dusting of snow is present. Winds channeled by topography redistribute the snow and actually remove it from regions. After freeze up has occurred and a continuous snow cover exists it is possible to identify open water reaches on streams flowing through the region. Such cases are identifiable on the ERTS images especially on the MSS 7 images.

N73-14333* Alaska Univ., College. Inst. of Water Resources. BREAK-UP CHARACTERISTICS OF CHENA RIVER BASIN Bimonthly Progress Report

Robert F. Carlson, Principal Investigator 30 Nov. 1972 3 p

(Contract NAS5-21833)

(E72-10345; NASA-CR-129659; BMPR-2) Avail: NTIS HC \$3.00 CSCL 08H

N73-14342* Environmental Research Inst. of Michigan, Ann Arbor.

PROGRESS AND PLANS OF A REMOTE SENSING PROGRAM FOR THE INTERNATIONAL FIELD YEAR FOR THE GREAT LAKES (IFYGL)

Fabian C. Polcyn and Thomas W. Wagner, Principal Investigators
19 Dec. 1972 13 p Original contains color imagery. Original
photography may be purchased from the EROS Data Center,
10th and Dakota Avenue, Sioux Falls, S. D. 57198
(Contract NAS5-21783)

(E72-10354; NASA-CR-129667; Rept-011229-14-L) Avail:
NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results.
ERTS-1 coverage of the 32,000 square mile Lake Ontario Basin
is being used to study short term and seasonal changes which
affect many aspects of water problems in the Great Lakes. As
part of the International Field Year for the Great Lakes (IFYGL),
a coordinated, synoptic study of the Lake Ontario Basin, processed
ERTS-1 imagery will contribute to the data base of synchronized
observations being made by investigators from many U.S. and
Canadian government agencies and universities. The first set of
ERTS data has been received and will be processed shortly for
parameters of hydrological and limnological significance such as
land use, terrain features, and water quality. When complete,
nine ERTS-1 frames recorded during a substantially clear period
will provide coverage of the entire Basin. Seven frames show
all but a small portion of the southern and eastern end of the
Basin. Many drainage basin characteristics are clearly identifiable
on the imagery.

N73-14350* # Wolf Research and Development Corp., Riverdale,
Md.

**THE INTERDEPENDENCE OF LAKE ICE AND CLIMATE IN
CENTRAL NORTH AMERICA** Interim Report, Jun. - Nov.
1972

Allan J. Jelacic, Principal Investigator Dec. 1972 54 p refs
(Contract NAS5-21761)

(E72-10362; NASA-CR-129692; IR-1) Avail: NTIS HC \$4.75
CSCL 08L

There are no author-identified significant results in this
report. This investigation is to identify any correlations between
the freeze/ thaw cycles of lakes and regional weather variations.
ERTS-1 imagery of central Canada and north central United States
is examined on a seasonal basis. The ice conditions of certain
major study lakes are noted and recorded on magnetic tape,
from which the movement of a freeze/thaw transition zone may
be deduced. Weather maps and tables are used to establish
any obvious correlations. The process of selecting major study
lakes is discussed, and a complete lake directory is presented.
Various routines of the software support library are described,
accompanied by output samples. Procedures used for ERTS
imagery processing are presented along with the data analysis
plan. Application of these procedures to selected ERTS imagery
has demonstrated their utility. Preliminary results show that the
freeze/thaw transition zone can be monitored from ERTS.

N73-14351* # Corps of Engineers, San Francisco, Calif.
CALIFORNIA COAST NEARSHORE PROCESSES STUDY
Progress Report, 1 Nov. - 31 Dec. 1972

Douglas M. Pirie, Principal Investigator 31 Dec. 1972 13 p
(NASA Order S-70257-AG)

(E72-10363; NASA-CR-129723; ERTS-1-1-2; PR-2) Avail:
NTIS HC \$3.00 CSCL 08A

The author has identified the following significant results. In
the Santa Barbara Channel the effect of the California and the
Anacapa Currents are clearly seen in image 1109-18073M. The
large triangular shaped lobe of suspended particulate matter that
stretches almost to Anacapa Island from the Ventura River area
is disrupted approximately midchannel by the east-moving
Anacapa Current. In the Point Conception area a lobe of suspended
material approximately 20 miles long can be seen moving eastward
as a result of the California Current. In the San Francisco Bay

area the major results include the detection and delineation of
the San Francisco Bay, the location and vector of suspended
sediment in the San Francisco Bay, and the ability to differentiate
morphologic units within the San Francisco Bay tidelands. Several
densitometer line traces seaward of the Golden Gate Bridge on
image 1075-18173-4 outline the San Francisco Bay and give
evidence of good water penetration.

N73-14364* California Univ., Davis. Dept. of Water Science.
**USER REQUIREMENTS FOR THE APPLICATION OF
REMOTE SENSING IN THE PLANNING AND MANAGE-
MENT OF WATER RESOURCE SYSTEMS**

Robert H. Burgy *In its* An Integrated Study of Earth Resources
in the State of Calif. Using Remote Sensing Techniques 1 May
1972 27 p refs

CSCL 08H

Data relating to hydrologic and water resource systems and
subsystems management are reported. Systems models, user
application, and remote sensing technology are covered.
Parameters governing water resources include evapotranspiration,
vegetation, precipitation, streams and estuaries, reservoirs and
lakes, and unsaturated and saturated soil zones. E.H.W.

N73-14398# Wisconsin Univ., Madison. Water Resources Center.
**DEVELOPMENT OF NEW TECHNIQUES FOR DELINEATION
OF FLOOD PLAIN HAZARD ZONES. PART 1: BY MEANS
OF DETAILED SOIL SURVEYS. PART 2: BY MEANS OF
AIR PHOTO INTERPRETATION**

Gerhard B. Lee, Dale E. Parker, Douglas A. Yanggen, and Clarence
J. Milfred 1972 104 p refs

(Contract Di-14-01-0001-861)

(PB-211325; OWRR-B-002-Wis(14)) Avail: NTIS HC \$3.00
CSCL 08H

Investigations are described which were designed to evaluate
interpretation of detailed soil maps, as a means of determining
flood plain boundaries for regulatory purposes. Similar studies
based on interpretation of airphotos are also described. Six
Wisconsin sites were studied. Boundaries of 100 year floods
determined by engineering methods were used as a basis of
comparison. Results showed that reasonably accurate boundaries
of 100 year floods can be drawn in many places by interpretation
of detailed soil maps. Results of air photo studies showed that
flood plain boundaries could also be drawn by interpretation of
aerial photographs, in areas where physiographic features were
distinct. GRA

N73-14402# Washington Univ., St. Louis, Mo.
**MEASUREMENT OF LATERAL EROSION AT PROPOSED
RIVER CROSSING SITES OF THE ALASKA PIPELINE**

James Brice 1971 45 p

(Grant DA-ARO(D)-31-124-70-G89)

(AD-748875; AROD-8623-1-EN) Avail: NTIS CSCL 08/H

The report presents a study of lateral erosion rates at proposed
river crossing sites of the Alaska pipeline by the comparison of
aerial photographs. Examination of river crossings between the
Yukon River and Prudhoe Bay was done by helicopter. Most of
the crossing sites described were examined in the field, in too
brief a time to permit quantitative measurements, but long enough
to be of much assistance in interpretation of the aerial photographs.

Author (GRA)

06 HYDROLOGY AND WATER MANAGEMENT

N73-14943* South Alabama Univ., Mobile. Environmental Applications Office.

A PRELIMINARY STUDY OF A BUOY SYSTEM FOR ACQUISITION, TRANSMISSION, AND MANAGEMENT OF HYDROLOGICAL DATA OBTAINED FROM IN-SITU MEASUREMENTS

J. Mark Elliott /in Auburn Univ. The NASA-ASEE Summer Fac. Fellowship Program Sep. 1972 p. 75-100 refs

CSCL 08H

N73-15337 Earth Satellite Corp., Washington, D.C. FACILITATING THE EXPLOITATION OF ERTS IMAGERY USING SNOW ENHANCEMENT TECHNIQUES Bimonthly Progress Report**

Frank J. Wobber, Principal Investigator, Kenneth Martin, Charles Sheffield, Orville Russell, and Roger Amato 3 Jan. 1973 28 p (Contract NAS5-21744)

(E73-10001; NASA-CR-129925) Avail: NTIS HC \$3.50 CSCL 08L

The author has identified the following significant results. EarthSat has established an effective mail-based method for obtaining timely ground truth (snow depth) information over an extensive area. The method is both efficient and inexpensive compared with the cost of a similarly scaled direct field checking effort. Additional geological information has been acquired which is not shown in geological maps in the area. Excellent quality snow-free ERTS-1 transparencies of the test areas have been received and are being analyzed.

N73-15349 Maine Dept. of Transportation, Augusta. TO MAP THE DISTRIBUTION OF GLACIOFLUVIAL DEPOSITS AND ASSOCIATED GLACIAL LANDFORMS Progress Report**

Raymond G. Woodman, Principal Investigator 1 Jan. 1973 3 p (Contract NAS5-21747)

(E73-10013; NASA-CR-129939; PR-4) Avail: NTIS HC \$3.00 CSCL 08B

N73-15352 National Environmental Satellite Service, Washington, D.C.**

EVALUATION OF ERTS DATA FOR CERTAIN HYDROLOGICAL USES Progress Report, Oct. - Nov. 1972

Donald R. Wiesnet and David F. McGinnis, Principal Investigators Nov. 1972 4 p

(NASA Order S-70246-AG)

(E73-10016; NASA-CR-129942) Avail: NTIS HC \$3.00 CSCL 08H

N73-15419# Edgerton, Germeshausen and Grier, Inc., Las Vegas, Nev.

WATER EQUIVALENT OF SNOW MEASUREMENTS USING NATURAL TERRAIN RADIATION

A. E. Fritzsche, Z. G. Burson, and D. L. Burge 22 Oct. 1971 65 p refs

(Contract AT(29-1)-1183)

(EGG-1183-1533; L-1047) Avail: NTIS

Aerial survey data were obtained from repeated surveys of two snow courses during fiscal years 1970 and 1971. Both gross count and spectral peak counting techniques from NaI crystals were used. Analysis indicates that water equivalent can be predicted to an accuracy of plus or minus 0.9 cm or 6%.

whichever is greater. These uncertainties can be further reduced by better delineation of the airborne radioactivity. Author (NSA)

N73-15425# Defence Research Establishment Ottawa (Ontario). PRESENT ARCTIC GLACIATION

Geoffrey F. Hattersley-Smith Mar. 1972 38 p refs

(AD-747001; DREO-TN-72-7) Avail: NTIS CSCL 08/12

The review was written as a chapter of the book Arctic and Alpine Regions. It reviews glacier classifications, surveys glacier regimes and discusses their roles in terms of their effect on climate, the eco system and their contributions to geomorphology and possible future economic uses. Recent progress in various aspects of glacier research are reviewed. Author (GRA)

N73-16299 Stanford Research Inst., Menlo Park, Calif.**

STUDY OF TIME LAPSE DATA PROCESSING FOR DYNAMIC HYDROLOGIC CONDITIONS Progress Report, 7 Nov. 1972 - 6 Jan. 1973

Sidney M. Serabreny, Principal Investigator 6 Jan. 1973 7 p

Original contains imagery. Original photography may be purchased from EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(Contract NAS5-21841)

(E73-10035; NASA-CR-129995) Avail: NTIS HC \$3.00 CSCL 08H

N73-16305 Texas Technological Univ., Lubbock. Dept. of Geosciences.**

DYNAMICS OF PLAYA LAKES IN THE TEXAS HIGH PLAINS Progress Report, 30 Nov. 1972 - 30 Jan. 1973

C. C. Reeves, Jr., Principal Investigator 30 Jan. 1973 3 p

(Contract NAS5-21720)

(E73-10042; NASA-CR-130321) Avail: NTIS HC \$3.00 CSCL 08H

N73-16308 National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.**

ERTS-1 OBSERVATIONS OF FLOOD DAMAGE IN WEST CENTRAL IOWA IN SEPTEMBER 1972

Albert Rango, V. V. Salomonson, S. Wiitala (Geol. Surv.), and P. J. Waite (NOAA) [1973] 1 p Proposed for presentation at the Spring 1973 Meeting of the Am. Geophys. Union, 16-20 Apr. 1973

(E73-10045; NASA-TM-X-68937) Avail: NTIS HC \$3.00 CSCL 08H

N73-16309 American Univ., Washington, D.C. Dept. of Biology.**

ERTS IMAGE ANALYSIS. SITE: INLAND DELTA OF NIGER RIVER, REPUBLIC OF MALI, WEST AFRICA Preliminary Report

Norman H. MacLeod, Principal Investigator Jan. 1973 4 p

(Contract NAS5-21889)

(E73-10047; NASA-CR-130324; Rept-1) Avail: NTIS HC \$3.00 CSCL 08H

N73-16317* Corps of Engineers, Waltham, Mass. New England Div.

THE USE OF ERTS IMAGERY IN RESERVOIR MANAGEMENT AND OPERATION Interim Report, Jun. - Dec. 1972
Saul Cooper, Principal Investigator Jan. 1973 29 p refs
(NASA Order S-70256-AG)

(E73-10055; NASA-CR-130333) Avail: NTIS HC \$3.50 CSCL 08H

There are no author-identified significant results in this report. Preliminary analysis of ERTS-1 imagery suggests that the configuration and areal coverage of surface waters, as well as other hydrologically related terrain features, may be obtained from ERTS-1 imagery to an extent that would be useful. Computer-oriented pattern recognition techniques are being developed to help automate the identification and analysis of hydrologic features. Considerable man-machine interaction is required while training the computer for these tasks.

N73-16319* Geological Survey, Arlington, Va.
DYNAMICS OF SUSPENDED SEDIMENT PLUMES IN LAKE ONTARIO Progress Report, 1 Sep. - 31 Oct. 1972

Edward J. Puhowski, Principal Investigator 1 Nov. 1972 2 p
(NASA Order S-70243-AG-2)

(E73-10057; NASA-CR-130308) Avail: NTIS HC \$3.00 CSCL 08C

N73-16325* Geological Survey, Tacoma, Wash.
EVALUATE ERTS IMAGERY FOR MAPPING AND DETECTION OF CHANGES OF SNOWCOVER ON LAND AND ON GLACIERS Progress Report, 1 Jul. - 31 Dec. 1972

Mark F. Meier, Principal Investigator 1 Jan. 1973 14 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(NASA Order S-70243-AG)
(E73-10063; NASA-CR-130313) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. The area of snow cover on land was determined from ERTS-1 imagery. Snow cover in specific drainage basins was measured with the Stanford Research Institute console by electronically superimposing basin outlines on imagery, with video density slicing to measure areas. Snow covered area and snowline altitudes were also determined by enlarging ERTS-1 imagery 1:250,000 and using a transparent map overlay. Under very favorable conditions, snowline altitude was determined to an accuracy of about 60 m. Ability to map snow cover or to determine snowline altitude depends primarily on cloud cover and vegetation and secondarily on slope, terrain roughness, sun angle, radiometric fidelity, and amount of spectral information available. Glacier accumulation area ratios were determined from ERTS-1 imagery. Also, subtle flow structures, undetected on aerial photographs, were visible. Surging glaciers were identified, and the changes resulting from the surge of a large glacier were measured as were changes in tidal glacier termini.

N73-16331* Delaware Univ., Newark. Coll. of Marine Studies.
APPLICATION OF AUTOMATED MULTISPECTRAL ANALYSIS TO DELAWARE'S COASTAL VEGETATION MAPPING
V. Klemas, Principal Investigator, D. Daiber, D. Bartlett, O. Crichton, and A. Fornes 16 Jan. 1973 6 p
(Contract NAS5-21837)

(E73-10069; NASA-CR-130355) Avail: NTIS HC \$3.00 CSCL 08J

There are no author-identified significant results in this report. Overlay maps of Delaware's wetlands have been prepared, showing the dominant species or group of species of vegetation present. Five such categories of vegetation were used indicating marshes dominated by: (1) salt marsh cord grass; (2) salt marsh hay and spike grass; (3) reed grass; (4) high tide bush and sea myrtle; and (5) a group of fresh water species found in impounded areas built to attract water fowl. Fifteen such maps cover

Delaware's wetlands from the Pennsylvania to the Maryland borders. The mapping technique employed utilizes the General Electric multispectral data processing system. This system is a hybrid analog-digital system designed as an analysis tool to be used by an operator whose own judgment and knowledge of ground truth can be incorporated at any time into the analyzing process. The result is a high speed, cost effective method for producing enhanced photomaps showing a number of spectral classes, each enhanced spectral class being representative of a vegetative species or group of species.

N73-16339* American Univ., Washington, D.C.
OBSERVATION OF PLANT GROWTH AND ANNUAL FLOODING IN THE INLAND DELTA OF THE NIGER RIVER, REPUBLIC OF MALI, WEST AFRICA Bimonthly Progress Report, 3 Nov. 1972 - 3 Jan. 1973

Norman H. MacLeod, Principal Investigator 3 Jan. 1973 2 p
(Contract NAS5-21892)

(E73-10078; NASA-CR-130024) Avail: NTIS HC \$3.00 CSCL 08H

N73-16402* National Oceanic and Atmospheric Administration, Washington, D.C.

REMOTE SENSING OF SNOW FIELDS FROM EARTH SATELLITES

Donald R. Baker In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 2 1971 p 430-440 refs

CSCL 08L

Considerable effort has gone into snow line delineation using available satellite data. Furthermore, increasing emphasis is being put on automated extraction of such information and generation of a useable product for hydrologists. Implications are clear that the impact from future satellite and sensors systems will create an increased demand for computer processing before the data can be used by the hydrologist. If the coarse-resolution, broad spectral band data available from current satellites already create a demand by hydrologists for computer processing of the data, it is obvious there will be an even greater demand for computer analysis and evaluation when the future ERTS data become available.

Author

N73-16403* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

NIMBUS 3 AND 4 OBSERVATIONS OF SNOW COVER AND OTHER HYDROLOGICAL FEATURES IN THE WESTERN HIMALAYAS

Vincent V. Salomonson In its Intern. Workshop on Earth Resources Surv. Systems, Vol. 2 1971 p 442-447

CSCL 08L

Photographs from the Nimbus 3 and 4 image dissector camera systems and high resolution infrared radiometers illustrate and demonstrate their applicability in observing snow cover and other hydrological features. This collection of imagery shows the relative merits of daily observations of these features in the visible, near infrared, and far infrared portions of the electromagnetic spectrum with sensors having nominal spatial resolutions between 4 and 8 kilometers. Particular emphasis has been placed on observing features associated with the Indus River because of the economic and social importance of this in the lives of millions of people. The overall results clearly indicate that it is feasible to monitor quantitatively the extent of the snow cover over the Indus River watershed during a given year and from one year to another using meteorological satellite imagery.

Author

N73-16404* Geological Survey, Harrisburg, Pa.
THE ROLE OF REMOTELY SENSED AND RELAYED DATA IN THE DELAWARE RIVER BASIN

Richard W. Paulson In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 2 1971 p 448-467 refs

06 HYDROLOGY AND WATER MANAGEMENT

CSCL 08H

The planned integration of the existing water quality monitoring and data processing systems in the Delaware River Basin with a data relay experiment proposed for the ERTS-1 is discussed. The experiment is designed to use ERTS-1 as a data relay link for a maximum of 20 hydrologic stations in the basin, including stream gaging, reservoir level, ground water level, and water quality monitoring stations. This experiment has the potential for reducing the time lag between data collection and dissemination to less than 12 hours. The experiment will also provide impetus to develop an operational system of real time data processing and dissemination to handle the large quantity of data that will be obtained from the stations in the basin. The results of this experiment will demonstrate the relative merits of satellite relay of data versus conventional means of data telemetry and will provide a basis for the development of operational satellite relay of hydrologic data. Author

N73-16405* Allied Research Associates, Inc., Lanham, Md. HYDROLOGIC CONDITIONS VIEWED BY THE NIMBUS METEOROLOGICAL SATELLITES

George A. Rabchevsky In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 2 1971 p 468-511 refs

CSCL 08H

The unexploited value of the Nimbus meteorological sensor data relates to the satellites' ability for global, temporal, repetitive and uniform tonal and spatial coverage of the earth's surface. Examples are presented illustrating how synoptic views of large areas increase interpretive capability and enable focusing on large targets of interest. The effect of resolution of the Nimbus imaging systems on these observations is discussed, together with the assessment of the areal and temporal magnitude of changes observed by these systems. Two case studies are presented exemplifying the satellites' ability for repetitive observations enabling phenomena to be monitored under special conditions. One study deals with changes observed in the Antarctic ice conditions utilizing the Nimbus 2 and 3 television picture data. The other study deals with terrestrial changes in the Mississippi River Valley and the Niger River Valley (Africa), observed primarily in the 0.7 to 1.3 micron spectral band. Author

N73-16443*# California Univ., Riverside. Dept. of Geography. THE DEFORMATION CHARACTERISTICS OF HILL SLOPES AND CHANNELWAYS IN TWO DIFFERENT ENVIRON- MENTS AS DEPICTED BY REMOTE SENSOR RETURNS

Donald H. Poole (East Tennessee State Univ., Johnson City) [1972] 54 p refs
(Grant NGL-05-003-404; Contracts F19628-69-C-0116; N00014-69-A-0200-5001; NR Proj. 387-047; Proj. Themis)
(NASA-CR-130379; AD-748642; TR-T-72-1) Avail: NTIS HC \$4.75 CSCL 08/6

Two forms of rapid mass wastage, mudflow and debris slide, are considered. Both forms of movement are studied in their environment of occurrence using a remote sensing approach. The two environments included Wildwood Canyon watershed in California and Davis Creek watershed in Virginia. Data sources include standard black and white aerial photography, Aero Ektachrome, and Aero Ektachrome Infrared (CIR) photography. A comparison of mass wastage phenomena in the two areas reveals many similarities in form, and between the physical character of the drainage ways. In Wildwood Canyon maximum deformation was limited to several small tributaries and the main channel. Both channel and widespread slope destruction occur throughout the Davis Creek drainage Basin. Results from the investigation indicate that considerable information related to mass wastage phenomena can be extracted from aerial photographs. Information interpreted from photographic images came from pattern, color contrasts and geometric form of mass wastage scars. Author

N73-17289*# National Aeronautics and Space Administration.
Goddard Space Flight Center, Greenbelt, Md.

REPETITIVE ERTS-1 OBSERVATIONS OF SURFACE WATER VARIABILITY ALONG RIVERS AND OTHER LOW LYING AREAS

Albert Rango and V. V. Salomonson [1973] 1 p Proposed for presentation at Remote Sensing of Water Resources Intern. Symp. of the Am. Water Resource Assoc., 11-14 Jun. 1973 (E73-10046; NASA-TM-X-68938) Avail: NTIS HC \$3.00 CSCL 08H

N73-17294*# Corps of Engineers, Champaign, Ill. EFFECTS OF CONSTRUCTION AND STAGED FILLING OF RESERVOIRS ON THE ENVIRONMENT AND ECOLOGY Progress Report, 8 Dec. 1972 - 8 Feb. 1973

Ravinder K. Jain, Principal Investigator 8 Feb. 1973 1 p
(NASA Order S-70265-AG)
(E73-10082; NASA-CR-130280) Avail: NTIS HC \$3.00 CSCL 08H

N73-17299*# Environmental Research and Technology, Inc., Lexington, Mass. USE OF ERTS DATA FOR MAPPING SNOW COVER IN THE WESTERN UNITED STATES Progress Report, 28 Jun. - 31 Dec. 1972

James C. Barnes, Principal Investigator and Clinton J. Bowley
Feb. 1973 22 p
(Contract NASS-21803)
(E73-10087; NASA-CR-130336; P-407-3) Avail: NTIS HC \$3.25 CSCL 08H

The author has identified the following significant results. Results of the analysis of the initial sample of ERTS-1 data indicate that the MSS-5 spectral band is the most useful for detecting and mapping mountain snow cover. At the ERTS-1 resolution, snow cover can be readily detected in the MSS-5 band and can be distinguished from clouds. Snow line elevations have been mapped for five mountain areas. In one case for the Salt-Verde watershed in Arizona good agreement is observed between the location of the snow line as mapped from the ERTS-1 data and as depicted on an aerial snow survey chart compiled a week earlier. Examination of data from the Arctic has revealed that multispectral data can provide information on glacial conditions that cannot be ascertained from observations in a single spectral band.

N73-17304*# Geological Survey, Miami, Fla. DEVELOPMENT DATA RELAY SYSTEM FOR MONITORING HYDROLOGIC CONDITIONS IN SOUTH AND CENTRAL FLORIDA Progress Report, 1 Oct. - 30 Nov. 1972

A. L. Higer, Principal Investigator 1 Dec. 1972 4 p
(NASA Order S-70243-AG-7)
(E73-10092; NASA-CR-130341) Avail: NTIS HC \$3.00 CSCL 08H

N73-17305*# Geological Survey, Hartford, Conn. ESTUARINE AND COASTAL WATER DYNAMICS CONTROL- LING SEDIMENT MOVEMENT AND PLUME DEVELOPMENT IN LONG ISLAND SOUND Progress Report, 1 Jul. - 31 Dec. 1972

Frederick H. Ruggles, Jr., Principal Investigator 5 Jan. 1973
3 p
(NASA Order S-70243-AG-3)
(E73-10093; NASA-CR-130342) Avail: NTIS HC \$3.00 CSCL 08C

N73-17487*# Army Cold Regions Research and Engineering Lab., Hanover, N.H. ARCTIC AND SUBARCTIC ENVIRONMENTAL ANALYSES UTILIZING ERTS-1 IMAGERY Bimonthly Progress Report, 23 Dec. 1972 - 23 Feb. 1973

Duwayne M. Anderson, H. L. McKim, R. K. Haugen, L. W. Gatto,
C. W. Slaughter, and T. Marlar, Principal Investigators 23 Feb.
1973 4 p

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(NASA Order S-70253-AG)
(E73-10279; NASA-CR-130582; BMRP-3) Avail: NTIS HC \$3.00 CSDL 08F

N73-17489* Alaska Univ., Fairbanks. Geophysical Inst.
SURVEY OF THE SEASONAL SNOW COVER OF ALASKA
Progress Report, Jul. 1972 - Jan. 1973
C. S. Benson, Principal Investigator and B. Holmgren 20 Feb. 1973 16 p
(Contract NAS5-21833)
(E73-10282; NASA-CR-130566) Avail: NTIS HC \$3.00 CSDL 08L

N73-17494* American Univ., Washington, D.C. Dept. of Biology.
ERTS-1 DATA USER INVESTIGATION OF WETLAND ECOLOGY Progress Report
Richard R. Anderson, Principal Investigator 15 Feb. 1973 3 p
(Contract NAS5-21752)
(E73-10288; NASA-CR-130571; PR-4) Avail: NTIS HC \$3.00 CSDL 08H

N73-17497* Alaska Univ., Fairbanks. Inst. of Water Resources.
BREAK-UP CHARACTERISTICS OF CHENA RIVER BASIN
Progress Report, Jul. 1972 - Jan. 1973
Robert F. Carlson, Principal Investigator 20 Feb. 1973 12 p
(Contract NAS5-21833)
(E73-10292; NASA-CR-130575) Avail: NTIS HC \$3.00 CSDL 08H

The author has identified the following significant results. While visually analyzing ERTS-1 data for August and September, 1972, it was found that lakes as small as 200 feet in diameter were visible on the imagery. An examination of the imagery for the Minto Lakes area shows that the lakes take on their darkest appearance in MSS band 6. The Tanana River which flows through this area appears quite light in band 5, quite dark in band 7, and is almost undetectable for band 6. The significance of these data are that potential surface storage could be measured for watersheds that have substantial numbers of lakes. This potential storage would be available to both spring runoff and summer precipitation. Caution must be shown because certain clouds cast a shadow that is similar to the lake appearance. The difference of the imagery for a lake and a river of the same band is due to the sediment load for the river. The Tanana River had a heavy glacial sediment load. The area of snow cover during the fall accumulation can be mapped in detail.

N73-17502* Minnesota Univ., Minneapolis. Space Science Center.
A STUDY OF MINNESOTA FORESTS AND LAKES USING DATA FROM EARTH RESOURCES TECHNOLOGY SATELLITES 8th-Month Progress Report, 1 Jul. - 31 Dec. 1972
31 Dec. 1972 38 p refs
(Grant NGL-24-005-283)
(NASA-CR-130548) Avail: NTIS HC \$4.00 CSDL 08B

This project is to foster and develop new applications of remote sensing under an interdisciplinary effort. Seven reports make up the specific projects presently being conducted throughout the State of Minnesota in cooperation with several agencies and municipalities. These are included under the general headings of: (1) applications of aerial photography and ERTS-1 data to agricultural, forest, and water resources management; (2) classification and dynamics of water and wetland resources of Minnesota; (3) studies of Lake Superior Bay; and (4) feasibility of detecting major air pollutants by earth-oriented satellite-borne sensors. Author

N73-18323* Forest Service, Fairbanks, Alaska.

DEMONSTRATING APPLICABILITY OF SATELLITE DATA TO HYDROLOGY: A BRIEF REPORT ON THE USABILITY OF SATELLITE IMAGES IN HYDROLOGY AND LIMNOLOGY
Kullervo Kuusela, Principal Investigator and Risto Kuittinen [1973]
3 p Sponsored by NASA
(E73-10101; NASA-CR-130529) Avail: NTIS HC \$3.00 CSDL 08H

N73-18340* Corps of Engineers, Waltham, Mass.
ERTS-1 DATA USER INVESTIGATION OF THE USE OF ERTS IMAGERY IN RESERVOIR MANAGEMENT AND OPERATION Progress Report, 14 Dec. 1972 - 14 Feb. 1973
Saul Cooper and Paul Bock, Principal Investigators 2 Mar. 1973 5 p
(NASA Order S-70256-AG)
(E73-10308; NASA-CR-130726) Avail: NTIS HC \$3.00 CSDL 08H

N73-18348* Geological Survey, Arlington, Va.
DYNAMICS OF SUSPENDED SEDIMENT IN LAKE ONTARIO
Progress Report, 1 Jul. - 31 Dec. 1972
Edward J. Pluhowski, Principal Investigator 1 Jan. 1973 8 p
(NASA Order S-70243-AG-2)
(E73-10318; NASA-CR-130734) Avail: NTIS HC \$3.00 CSDL 08H

The author has identified the following significant results. The suspended sediment plumes generated by the Welland Canal and the Genesee River are identifiable in most band 5 frames received from ERTS-1. In descending order of value for plume detection in Lake Ontario are bands 4, 6, and 7. Little or no information content relative to plume detection is available in band 7. The Oswego River plume was not visible during low flow periods; however, it was identifiable immediately following storms. Increased suspended sediment loading emanating from storm runoff increases turbidity levels to the point where the plume becomes visible in the ERTS-1 imagery. Despite the fact that it is detectable from high altitude (80,000 feet) photography, the Niagara River plume was not visible in any of the ERTS-1 frames. Numerous examples of shoreline erosion were evident in the December 7, 1972, imagery of western Lake Ontario. Near shore lake circulation patterns are usually apparent whenever turbidity plumes are sensed by the satellite.

N73-18350* Geological Survey, Lakewood, Colo. Water Resources Div.
DETERMINE THE UTILITY OF ERTS-1 IMAGERY IN THE PREPARATION OF HYDROLOGIC ATLASES OF ARID LAND WATERSHEDS Progress Report, 1 Jul. - 31 Dec. 1972
Lynn M. Shown, Principal Investigator and J. Robert Owen 1 Jan. 1973 6 p
(NASA Order S-70243-AG)
(E73-10318; NASA-CR-130736) Avail: NTIS HC \$3.00 CSDL 08H

The author has identified the following significant results. The 9x9-inch transparencies from the ERTS-1 system seem to have better contrast in vegetation and drainage features than the 70-mm transparencies. This imagery can be magnified about eight times before it becomes excessively grainy. Imagery in band 7 appears to be the best single band product for viewing landform-water complexes. Band 5 best defines vegetation patterns. Multispectral color-additive viewing would appear to improve the separation of vegetation types where the vegetation exhibits moderate to strong infrared reflectance. Multispectral viewing did not appear to improve relief of drainage channel detail. False-color aerial infrared photographs at a scale of 1:120,000 for the Utah test site are excellent quality and can be magnified as much as 15 times without serious loss of contrast or excessive fuzziness. In desert areas with sparse to moderate shrub cover, the contrast between the soil background and the plant cover is so low that texture cannot be seen, even under high magnification. In areas of higher rainfall during the summer it is possible to discriminate coniferous and deciduous trees, grass, and shrub communities and to identify different rangeland treatment practices.

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N73-18356* Norwegian Water Resources and Electricity Board, Oslo.
HYDROLOGICAL INVESTIGATIONS IN NORWAY Progress Report, 23 Oct. 1972 - 23 Jan. 1973
 Helge A. Odegaard and Johnny Skurve, Principal Investigators
 5 Feb. 1973 8 p Sponsored by NASA
 (E73-10324; NASA-CR-130742) Avail: NTIS HC \$3.00 CSCL 08H

N73-18357* Delaware Univ., Newark. Coll. of Marine Sciences.
DYNAMICS OF PLANKTON POPULATIONS IN UPWELLING AREAS
 Karl-Heinz Szekleida, Principal Investigator Feb. 1973 6 p
 (Contract NAS5-21784)
 (E73-10325; NASA-CR-130780) Avail: NTIS HC \$3.00 CSCL 08A

N73-18362* Geological Survey, Phoenix, Ariz.
APPLICATIONS OF ERTS-A DATA COLLECTION SYSTEM (DCS) IN THE ARIZONA REGIONAL ECOLOGICAL TEST SITE (ARETS) Progress Report, 15 Oct. - 15 Dec. 1972
 Herbert H. Schumann, Principal Investigator 15 Dec. 1972 3 p
 (NASA Order S-70243-AG-7)
 (E73-10332; NASA-CR-130782) Avail: NTIS HC \$3.00 CSCL 08D

The author has identified the following significant results. Preliminary analysis of DCS data from the USGS-Verde River stream flow measuring site indicates the DCS system is furnishing high quality data more frequently than had been expected. During the 43-day period between Nov. 3, and Dec. 15, 1972, 552 DCS transmissions were received during 193 data passes. The amount of data received far exceeded the single high quality transmission per 12-hour period expected from the DCS system. The digital-parallel ERTS-1 data has furnished sufficient to accurately compute mean daily gage heights. These in turn, are used to compute average daily streamflow rates during periods of stable or slowly changing flow conditions. The digital-parallel data has also furnished useful information during peak flow periods. However, the serial-digital DCS capability, currently under development for transmitting streamflow data, should provide data of greater utility for determining times of flood peaks.

N73-18363* Geological Survey, Phoenix, Ariz.
APPLICATIONS OF ERTS-A DATA COLLECTION SYSTEM (DCS) IN THE ARIZONA REGIONAL ECOLOGICAL TEST SITE (ARETS) Progress Report, 15 Aug. - 15 Oct. 1972
 Herbert H. Schumann, Principal Investigator 15 Oct. 1972 3 p
 (NASA Order S-70243-AG-7)
 (E73-10333; NASA-CR-130783) Avail: NTIS HC \$3.00 CSCL 08D

N73-18396* University of Southern Mississippi, Hattiesburg.
REMOTE SENSING STUDY OF LAND USE AND SEDIMENTATION IN THE ROSS BARNETT RESERVOIR, JACKSON, MISSISSIPPI AREA
 W. T. Meador, Jr., T. W. Pinson, D. L. Wertz, C. M. Hoskin, and D. C. Williams [1972] 97 p
 (Grant NGL-25-005-007)
 (NASA-CR-130960; AR-1) Avail: NTIS HC \$7.00 CSCL 08H

This multi-year study is aimed at focusing on the recognition of sediment and other effluents in a selected area of the Ross Barnett Reservoir. The principle objectives are the determination of land use types, effect of land use on erosion, and the correlation of sediment with land use in the area. The I2S multi-band imagery was employed in conjunction with ground truth data for both water and land use studies. The selected test site contains approximately forty square miles including forest, open land, and water in addition to residential and recreational areas. J.M.M.

N73-18349* Maine Dept. of Transportation, Augusta.

TO MAP THE DISTRIBUTION OF GLACIOFLUVIAL DEPOSITS AND ASSOCIATED GLACIAL LANDFORMS Progress Report
 Raymond G. Woodman, Principal Investigator 13 Mar. 1973 1 p
 (Contract NAS5-21747)
 (E73-10353; NASA-CR-130834; PR-5) Avail: NTIS HC \$3.00 CSCL 08G

N73-19355* Agricultural Research Service, Chickasha, Okla.
INVESTIGATION OF USE OF SPACE DATA IN WATERSHED HYDROLOGY Progress Report, 10 Jun. 1972 - 30 Jan. 1973
 Bruce J. Blanchard, Principal Investigator Mar. 1973 12 p
 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
 (NASA Order S-70251-AG-4)
 (E73-10359; NASA-CR-130974) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. Ground truth data have been compiled and 256 rainfall runoff events have been used to determine coefficients for two storm runoff equations that apply to the 20 study watersheds. Two scenes have been processed using CCT data. Data pertinent to each of the study watersheds have been excerpted from the tapes. A computer program and display technique has been developed to retrieve the data from irregular shaped areas and store it in a format that allows future display of only the area desired. Means, standard deviations, and distributions have been determined for extreme dry and extreme wet conditions in the dormant season. Mean digital values show some variation between watersheds when dry, but no significant differences when wet. Standard deviations of digital values diminish drastically under wet dormant conditions. Thus the standard deviations may be a good indicator of influence of moisture. Distributions of seven bit values show that odd numbers are prevalent and irregular distribution may influence some classification schemes now in use.

N73-19357* Environmental Research and Technology, Inc., Lexington, Mass.
EVALUATE THE APPLICATION OF ERTS-A DATA FOR DETECTING AND MAPPING SNOW COVER Bimonthly Progress Report, 31 Dec. 1972 - 28 Feb. 1973
 James C. Barnes, Principal Investigator 15 Mar. 1973 11 p
 (Contract NAS5-21802)
 (E73-10361; NASA-CR-130982; ERT-P-407-4; BMPR-3) Avail: NTIS HC \$3.00 CSCL 08L

The author has identified the following significant results. Analysis of ERTS-1 data covering the test sites in the western United States indicate that the MSS-4 and 5 spectral bands are the most useful for detecting and mapping snow cover. Of these two bands, the MSS-5 is the most consistently useful, as snow-covered areas in some MSS-4 images are nearly saturated causing some loss of detail. Snow can be readily detected and can be distinguished from clouds through a number of interpretive keys. At the ERTS-1 resolution, numerous terrestrial features not visible in lower resolution meteorological satellite data can be detected. In addition to various natural features, man-made features such as roads, electric power lines, cultivated fields, and timber cuts are visible. In two cases analyzed for the Salt-Verde Watershed in Arizona, good agreement is observed between the location of the snowline as mapped from the ERTS-1 data and as depicted on aerial snow survey charts compiled within a few days of the ERTS-1 passage. Results indicate that the snowline can be mapped in more detail from ERTS-1 imagery than can be achieved by current aerial survey methods.

N73-19358* American Univ., Washington, D.C.
MAPPING SOUTHERN ATLANTIC COASTAL MARSHLAND, SOUTH CAROLINA-GEORGIA, USING ERTS-1 IMAGERY
 Richard R. Anderson, Principal Investigator, Virginia Carter, and John W. McGinness [1973] 9 p refs Presented at Remote

Sensing Conf., Tenn. Univ. Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 (Contract NAS5-21752) (E73-10362; NASA-CR-130995) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. Southeastern coastal marshes are among the most extensive and productive in the United States. A relatively low cost, moderately accurate method is needed to map these areas for management and protection. Ground based and low altitude aircraft methods for mapping are time consuming and quite expensive. The launch of NASA's ERTS-1 has provided an opportunity to test the feasibility of mapping wetlands using small scale imagery. The test site selected was an area from the South Carolina border to Saint Catherine's Island, Georgia. Results of the investigation indicate that the following may be ascertained from ERTS-1 imagery: (1) upper wetland boundary; (2) drainage pattern in the wetland; (3) plant communities such as *Spartina alterniflora*, *Spartina patens*, *Juncus roemerianus*; (4) ditching activities associated with agriculture; (5) lagooning for water-side home development. Conclusions are that ERTS-1 will be an excellent tool for many types of coastal wetland mapping.

N73-19359* American Univ., Washington, D.C.
MAPPING NORTHERN ATLANTIC COASTAL MARSHLANDS, MARYLAND-VIRGINIA, USING ERTS IMAGERY
Richard R. Anderson, Principal Investigator, Virginia Carter, and John W. McGinness [1973] 11 p Presented at Remote Sensing Conf., Tenn. Univ. Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 (Contract NAS5-21752) (E73-10363; NASA-CR-130996) Avail: NTIS HC \$3.00 CSCL 08B

The author has identified the following significant results. ERTS-1 data provides repetitive synoptic coverage for analysis of wetland ecology, detection of change, and mapping or inventory of wetland boundaries and plant communities. ERTS-1 positive transparencies of Atlantic Coastal wetlands were enlarged to different scales and mapped using a variety of methods. Results of analysis indicate: (1) mapping of wetland boundaries and vegetative communities from imagery at a scale of 1:1,000,000 is impractical because small details are difficult to illustrate; (2) mapping to a scale of 1:250,000 is practical for defining land-water interface, upper wetland boundary, gross vegetative communities, and spoil disposal/dredge and fill operations; (3) 1:125,000 enlargements provide additional information on transition zones, smaller plant communities, and drainage or mosquito ditching. Overlays may be made directly from prints.

N73-19363* Delaware Univ., Newark. Coll. of Marine Studies.
IDENTIFICATION OF MARSH VEGETATION AND COASTAL LAND USE IN ERTS-1 IMAGERY
V. Klemas, Principal Investigator and D. Bartlett 21 Mar. 1973 14 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 (Contract NAS5-21837; N00014-69-A-0407) (E73-10367; NASA-CR-131008) Avail: NTIS HC \$3.00 CSCL 08B

N73-19370* Army Engineer District, Los Angeles, Calif.
CALIFORNIA COAST NEARSHORE PROCESSES STUDY
Progress Report, 1 Sep. 1972 - 28 Feb. 1973
Douglas M. Pirie and David D. Steller, Principal Investigators Mar. 1973 38 p refs Prepared in cooperation with Rockwell Intern. Corp. Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 (NASA Order S-70257-AG) (E73-10375; NASA-CR-131016; ERTS-1-2-1) Avail: NTIS

HC \$4.00 CSCL 08H

The author has identified the following significant results. This report contains the techniques used for enhancing and analyzing nearshore processes from ERTS-1 and aircraft data. Four California nearshore sites are used as test cells including the San Francisco area, Monterey Bay, Santa Barbara Channel, and Los Angeles area. Techniques used for analyzing the test cells included direct photographic processing, computer compatible tape gain change enhancement, discrete point density analysis and plotting, and densitometer enhancement. Using these methods, it is possible to measure the seaward extent of the suspended sediment transport and to differentiate sediment levels within the individual sediment lobes. The movement of riverine discharged suspensates and coastal sediments by currents was an intricate part of the sediment transport analysis. The larger estuaries in the test cell areas were also studied for flushing characteristics.

N73-19373* Geological Survey, Hartford, Conn.
ESTUARINE AND COASTAL WATER DYNAMICS CONTROLLING SEDIMENT MOVEMENT AND PLUME DEVELOPMENT IN LONG ISLAND SOUND Progress Report, 1 Jan. - 28 Feb. 1973
Frederick H. Ruggles, Jr., Principal Investigator 28 Feb. 1973 2 p (NASA Order S-70243-AG-3) (E73-10378; NASA-CR-131019) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. As the Connecticut River flows into Long Island Sound, large plumes develop during the mixing of ocean and estuarine waters. Plumes were delineated for July 28, October 8, October 27, and December 2, 1972, by analyzing ERTS-1 imagery with the SRI Electronic Satellite Image Analysis Console (ESIAC). Because the chemical and physical composition of the plume and ocean water were not too different, the ESIAC was utilized to expand the scenes and subject the transparencies to varying combinations of viewing techniques to identify and delineate the plumes. Best results were obtained when band 5 transparencies were used. Indications are, when the scene being analyzed is predominantly in the first two steps of the gray scale, it is best to use the negative transparencies. When the analysis is being done above the first two steps of the gray scale, it is best to use the positive transparencies.

N73-19374* Geological Survey, Tacoma, Wash.
EVALUATE ERTS IMAGERY FOR MAPPING AND DETECTION OF CHANGES OF SNOWCOVER ON LAND AND ON GLACIERS Progress Report, 1 Jan. - 28 Feb. 1973
Mark F. Meier, Principal Investigator 27 Feb. 1973 3 p (NASA Order S-70243-AG-2) (E73-10379; NASA-CR-131020) Avail: NTIS HC \$3.00 CSCL 08L

The author has identified the following significant results. The percentage of snow cover area on specific drainage basins was measured from ERTS-1 imagery by video density slicing with a repeatability of 4 percent of the snow covered area. Data from ERTS-1 images of the melt season snow cover in the Thunder Creek drainage basin in the North Cascades were combined with existing hydrologic and meteorologic observations to enable calculations of the time distribution of the water stored in this mountain snowpack. Similar data could be used for frequent updating of expected inflow to reservoirs. Equivalent snowline altitudes were determined from area measurements. Snowline altitudes were also determined by combining enlarged ERTS-1 images with maps. ERTS-1 imagery was also successfully used to measure glacier accumulation area ratios for a small test basin.

N73-20355* Environmental Research Inst. of Michigan, Ann Arbor.
TASK 6: IFYGL (LAKE ONTARIO), 1384
Fabian C. Polcyn, Principal Investigator In its Process. and Analysis

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of ERTS-1 Remotely Sensed Data 15 Mar. 1973 9 p refs
Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
(E73-10393) CSCL 08H

The author has identified the following significant results. The Lake Ontario drainage basin covers over 32,000 miles of U.S. and Canadian territory. ERTS-1 data is contributing to the comprehensive study of this basin as part of the International Field Year for the Great Lakes (IFYGL). A processing approach is described for obtaining detailed and objective synoptic information thought to be applicable to terrestrial water balance studies of such a large area. A simple ratio algorithm was tested for minimizing daily variations in ERTS-1 data and for allowing the discrimination of surface features and land use classes of hydrologic significance. These steps are necessary if ERTS-1 data is to provide the quantitative information required for the study and management of areas of regional size.

N73-20362* Alaska Univ., Fairbanks. Inst. of Water Resources. **BREAK-UP CHARACTERISTICS OF CHENA RIVER BASIN** Bimonthly Progress Report
Robert F. Carlson, Principal Investigator 31 Mar. 1973 2 p
(Contract NAS5-21833)
(E73-10400; NASA-CR-131136; BMPR-4) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. Utilization of the color additive viewer was made to delineate snow boundary conditions from imagery taken during the fall snow accumulation period. By using filters that falsely colored the vegetation red, the snow cover appeared white.

N73-20377* Stanford Research Inst., Menlo Park, Calif. **STUDY OF TIME LAPSE PROCESSING FOR DYNAMIC HYDROLOGIC CONDITIONS** Progress Report, 6 Sep. 1972 - 6 Mar. 1973
Sidney M. Serebreny, Principal Investigator 26 Apr. 1973 9 p
(Contract NAS5-21841)
(E73-10415; NASA-CR-131151) Avail: NTIS HC \$3.00 CSCL 08H

N73-20393* Vermont Univ., Burlington. Dept. of Geology. **ENVIRONMENTAL STUDY OF ERTS-A IMAGERY LAKE CHAMPLAIN BASIN AND VERMONT** Bimonthly Report, period ending 1 Mar. 1973
Aulis O. Lind, Principal Investigator 1973 4 p
(Contract NAS5-21753)
(E73-10432; NASA-CR-131222) Avail: NTIS HC \$3.00 CSCL 08H

N73-20396* American Univ., Washington, D.C. **OBSERVATIONS OF THE PLANT GROWTH AND ANNUAL FLOODING IN THE INLAND DELTA OF THE NIGER RIVER, WEST AFRICA** Bimonthly Report
N. H. MacLeod, Principal Investigator Apr. 1973 8 p
(Contract NAS5-21889)
(E73-10436; NASA-CR-131226; BMR-2) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. A large potential irrigation area with water delivery system in place was identified from ERTS-1 imagery. The site is in the Sahara Desert. Color additive change detection imagery was used to assess ground water potentials in the Savannah in conjunction with a major US AID-Mali livestock sector initiative. The potential capacity to map laterite deposits in the Inland Delta from space was established with the help of aerial and ground surveys. A color composite of the Inland Delta could have saved French biogeographers 3 5/8 man-years of professional field work had it been available, according to the man who prepared a plant community map of part of the southern Inland Delta.

N73-20398* Alaska Univ., Fairbanks. **SURVEY OF THE SEASONAL SNOW COVER IN ALASKA** Bimonthly Progress Report
Gunter Weller, Principal Investigator 31 Mar. 1973 4 p refs
(Contract NAS5-21833)
(E73-10438; NASA-CR-131232; BMPR-4) Avail: NTIS HC \$3.00 CSCL 08L

The author has identified the following significant results. ERTS-1 data are used together with synoptic-climatological data to describe the buildup of the seasonal snow and ice covers in a north-south transect of a total length of about 1250 km across Alaska. It has been demonstrated that the ERTS-1 data may, under favorable conditions, be used for accurate mapping of snow lines in high mountain regions. The analysis shows that especially in the Brooks Range and on the Arctic Slope where snow covers generally are relatively thin, the ERTS-1 scenes can be useful for qualitative descriptions of the snow and ice covers over wide expanses. The onset and retreat of the seasonal snow cover are sensitive indicators of climatic fluctuations and the ERTS-1 data offers a possibility to record variations of the snow and ice buildup from year to year in a practical and informative way, which should be especially useful for studies of climatic trends. This is particularly true in Alaska where the density of the station network is too low to permit interpolations between the stations. A.L.

N73-20414* Texas Technological Univ., Lubbock. Dept. of Geosciences. **DYNAMICS OF PLAYA LAKES IN THE TEXAS HIGH PLAINS** Progress Report, Oct. 1972 - Mar. 1973
C. C. Reeves, Jr., Principal Investigator 31 Mar. 1973 13 p
(Contract NAS5-21720)
(E73-10455; NASA-CR-131255) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. ERTS-1 MSS imagery has been found useful for taking a regional wet census of the tens of thousands of lake basins on the Southern High Plains, Texas and New Mexico. Once the ground truth which has been correlated with the MSS imagery, is correlated with CCT data, and reliable computer classifications are determined, a lake census from CCT printouts will be possible. Correlation of satellite imagery products with water fluctuations and water budget is also underway.

N73-20420* Wisconsin Univ., Milwaukee. Air Pollution Analysis Lab. **THE USE OF ERTS-1 SATELLITE DATA IN GREAT LAKES MESOMETEOROLOGICAL STUDIES** Progress Report
Walter A. Lyons, Principal Investigator 30 Nov. 1972 10 p
(Contract NAS5-21738)
(E73-10464; NASA-CR-131271) Avail: NTIS HC \$3.00 CSCL 04B

The author has identified the following significant results. In the original proposal, it was hoped that ERTS could, with its extremely high resolution and multispectral capability, detect many meteorological phenomena occurring at the low end of the mesoscale motion spectrum (1 - 100 km). This included convective cloud phenomena, internal wave patterns, air pollution, snow squalls, etc. For meteorologists, ERTS-1 has more than lived up to initial hopes. First-look inspection of images has produced a large number of truly remarkable finds. Some of the most significant are: (1) Images of Lake Ontario during late summer have revealed several extremely good examples of lake breeze frontal cloud patterns. (2) Detection of suspended particulates from Chicago-Gary industrial complex in the 50,000 to 150,000 tons/year category. (3) Inadvertent weather modification due to anthropogenic condensation and ice nuclei from urban areas, areas.

N73-20449* Army Cold Regions Research and Engineering Lab., Hanover, N.H. **THE USE OF ERTS-1 IMAGERY IN THE NATIONAL PROGRAM FOR THE INSPECTION OF DAMS**

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Harlan L. McKim, Thomas L. Marlar, and Duwayne M. Anderson
Dec. 1972 23 p refs

(AD-754579; CRREL-SR-183) Avail: NTIS CSCL 13/2

ERTS-1 imagery can be useful in locating circular water bodies over 152 m (500 ft) in diameter. Dams on streams can be identified by an abrupt change in stream width. A linear termination on a water body is a reliable indication of a dam, particularly when it is inconsistent with the normal drainage pattern. Care must be exercised to avoid confusing cloud shadows with water bodies. However, the association of a cloud with its shadow usually can be accomplished since the sun angle is noted in the data given on each ERTS image. Author (GRA)

N73-21299*# Geological Survey, Harrisburg, Pa.
NEAR REAL TIME WATER RESOURCES DATA FOR RIVER BASIN MANAGEMENT Progress Report, 1 Jul. - 31 Dec. 1972

Richard W. Paulson, Principal Investigator 24 Jan. 1973 39 p
Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 Original contains color illustrations ERTS (NASA Order S-70243-AG)
(E73-10451; NASA-CR-131253) Avail: NTIS HC \$4.00 CSCL 08H

The author has identified the following significant results. Twenty Data Collection Platforms (DCP) are being field installed on USGS water resources stations in the Delaware River Basin. DCP's have been successfully installed and are operating well on five stream gaging stations, three observation wells, and one water quality monitor in the basin. DCP's have been installed at nine additional water quality monitors, and work is progressing on interfacing the platforms to the monitors. ERTS-related water resources data from the platforms are being provided in near real time, by the Goddard Space Flight Center to the Pennsylvania district, Water Resources Division, U.S. Geological Survey. On a daily basis, the data are computer processed by the Survey and provided to the Delaware River Basin Commission. Each daily summary contains data that were relayed during 4 or 5 of the 15 orbits made by ERTS-1 during the previous day. Water resources parameters relayed by the platforms include dissolved oxygen concentrations, temperature, pH, specific conductance, well level, and stream gage height, which is used to compute stream flow for the daily summary.

N73-21304*# National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, Tex.

EVALUATION OF SATELLITE REMOTE SENSING AND AUTOMATIC DATA TECHNIQUES FOR CHARACTERIZATION OF WETLANDS AND MARSHLANDS Progress Report, period ending 28 Feb 1972

Robert H. Cartmill, Principal Investigator 22 Mar. 1973 3 p ERTS

(E73-10467; NASA-TM-X-69128) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. Using the 12S Digicor color additive viewer and eight color classification map has been produced of a portion of the study area. Channel 3 of the MSS produced the best map. Enlargements of the MSS data have been accomplished by using the Data Analysis Station. The attached film recorder has three color guns which are capable of placing 2400 square elements across a 9 inch film. It has been found that by repeating ERTS element 9 times and each scan line 13 times that a map of a scale approximately 1:62,000 can be produced as a color negative film strip. This can be contact printed to produce a color map of the scale. As yet this procedure does not correct for image skew caused by rotation which is believed to be the major source of distortion and blockiness in the image. However, the final product which has not undergone any photographic enlargement is superior to photographically enlarged maps of the same scale.

N73-21306*# Department of the Environment, Ottawa (Ontario).

Applied Hydrology Div.

WATER SURVEY OF CANADA: APPLICATION FOR USE OF ERTS-A FOR RETRANSMISSION OF WATER RESOURCES DATA Progress Report, Jul. - Dec. 1972

R. A. Halliday, Principal Investigator Mar. 1973 10 p Sponsored by NASA ERTS

(E73-10469; NASA-CR-131277) Avail: NTIS CSCL 08H

The author has identified the following significant results. Nine sites in isolated regions in Canada have been selected for installation of ERTS data collection platforms. Seven platforms were installed in 1972, one of which did not operate. The six operating platforms transmitted over 7000 water level readings from stream gauging stations. This data is available on a near real time basis through the Canada Center for Remote Sensing and is used for river flow forecasting. The practicability of using satellite retransmission as a means of obtaining data from remote areas has been demonstrated.

N73-21322*# National Environmental Satellite Service, Washington, D.C.

EVALUATION OF ERTS DATA FOR CERTAIN HYDROLOGICAL USES Progress Report, Feb. - Mar. 1973

Donald R. Wiesnet and David F. McGinnis, Principal Investigators Mar. 1973 4 p ERTS

(NASA Order S-70246-AG)

(E73-10485; NASA-CR-131305) Avail: NTIS HC \$3.00 CSCL 08H

N73-21324*# American Univ., Washington, D.C.

A PRELIMINARY EVALUATION OF DRY SEASON/DROUGHT STATUS IN THE SAHELIAN ZONE OF MALI, MAURITANIA AND SENEGAL, BASED ON ERTS-1 IMAGERY

Norman H. MacLeod, Principal Investigator, Priscilla Reining (Catholic Univ. of Am.), and Jane Schubert 23 Apr. 1973 5 p refs ERTS

(Contract NAS5-21892)

(E73-10488; NASA-CR-131308) Avail: NTIS HC \$3.00 CSCL 08H

N73-21325*# Bureau of Reclamation, Denver, Colo.

MONITOR WEATHER CONDITIONS FOR CLOUD SEEDING CONTROL Progress Report, 1 Jan. - 1 Apr. 1973

Archie M. Kahan, Principal Investigator 2 Apr. 1973 3 p ERTS (NASA Order S-70243-AG-8)

(E73-10489; NASA-CR-131309) Avail: NTIS HC \$3.00 CSCL 04B

N73-21327*# Geological Survey, Miami, Fla.

DEVELOPING A DATA RELAY NETWORK FOR MONITORING HYDROLOGIC CONDITIONS IN SOUTH AND CENTRAL FLORIDA Progress Report, 1 Dec. 1972 - 1 Feb. 1973

A. L. Higer, Principal Investigator, E. T. Wimberly, and E. H. Cordes 2 Feb. 1973 9 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (NASA Order S-70243-AG-7)

(E73-10491; NASA-CR-131311) Avail: NTIS HC \$3.00 CSCL 08H

N73-21329*# Geological Survey, Arlington, Va.

DYNAMICS OF SUSPENDED SEDIMENT PLUMES IN LAKE ONTARIO Progress Report, 1 Jan. - 28 Feb. 1973

Edward J. Pluhowski, Principal Investigator 1 Mar. 1973 3 p ERTS

(NASA Order S-70243-AG-2)

(E73-10493; NASA-CR-131313) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. Owing to the normally heavy cloud cover over the lake during the winter, just one ERTS-1 frame was received during the report

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period. This imagery, obtained January 29, 1973 shows that the highly turbid waters from the Welland Canal and Port Dalhousie harbor commonly seen during the shipping season were not in evidence. Instead, only a broad band of slightly turbid waters extending about 2 to 3 miles into the lake is visible from just west of Port Dalhousie to the Niagara River outlet. A broad band of altocumulus clouds east of the Niagara River precluded study of nearly all of the New York shoreline.

N73-21350* California Univ., Davis. Dept. of Water Science and Engineering.

DEFINITION OF THE INFORMATIONAL REQUIREMENTS OF HYDROLOGIC RESOURCE MANAGERS

Robert H. Burgy and David R. Storm *In its* An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Tech. 1 Feb. 1971 8 p

CSSL 08H

The objectives of the integrated study are: (1) to delineate the parameters involved in hydrologic systems; (2) to outline the conventional means used in acquiring information relative to those parameters; and (3) to consider the potential usefulness of modern remote sensing techniques for acquiring certain parts of this information. Author

N73-21351* California Univ., Berkeley. Forestry Remote Sensing Lab.

MEASUREMENT OF HYDROLOGIC RESOURCE PARAMETERS THROUGH REMOTE SENSING IN THE FEATHER RIVER HEADWATERS AREA

Gene A. Thorley, William Draeger, Donald Lauer, Jerry Lent, and Edwin Roberts *In its* An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Tech. 1 Feb. 1971 4 p Original contains color illustrations

CSSL 08H

The four problem areas being investigated are: (1) determination of the feasibility of providing the resource manager with operationally useful information through the use of remote sensing techniques; (2) definition of the spectral characteristics of earth resources and the optimum procedures for calibrating tone and color characteristics of multispectral imagery (3) determination of the extent to which humans can extract useful earth resource information through remote sensing imagery; (4) determination of the extent to which automatic classification and data processing can extract useful information from remote sensing data. Author

N73-21352* California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.

RIVER MEANDER STUDIES

Gerald Schubert and Richard Lingenfelter *In its* An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Tech. 1 Feb. 1971 6 p

CSSL 08E

The feasibility of using satellite television photography of geomorphological indices to obtain a correlation between a stream meander power spectrum and stream discharge frequency distribution is considered. Water resources assessment includes information on the average rainfall over large drainage basins and calculations relating flow measurements to geographical areas. Photoelectric optical scanning techniques provide a digitized procedure for locating and following river meander curve points. G.G.

N73-21353* California Univ., Santa Barbara. Dept. of Geography. **ASSESSMENT OF THE IMPACT OF THE CALIFORNIA WATER PROJECT IN THE WEST SIDE OF THE SAN JOAQUIN VALLEY**

John E. Estes, Michael Kuhn, Berl Golomb, Leslie W. Senger, Lyndon Wester, Patrick Fortune, and James Viellenave *In its* An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Tech. 1 Feb. 1971 30 p refs Original contains color illustrations

CSSL 08H

The ability of remote sensing techniques to effectively monitor, on a continuing basis, the impact of a change in the water supply of an arid area is considered. Research involves the collection of a substantial body of information relative to both physical and biological phenomena or systems operative within the study area by concentrating on the accumulation of library materials, and field data. Author

N73-21354* California Univ., Riverside. Dept. of Geography. **ASSESSMENT OF THE IMPACT OF THE CALIFORNIA WATER PROJECT IN SOUTHERN CALIFORNIA**

Leonard W. Bowden, W. G. Brooner, H. P. Bailey, V. B. Coleman, P. T. Dykman, C. W. Johnson, and R. W. Pease *In its* An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Tech. 1 Feb. 1971 35 p

CSSL 08H

As the California State Water Project progresses and enters operation, it is suggested that changes in land use which may be monitored and analyzed by remote sensing techniques will follow suite. Progress in each of these areas of research and automated mapping techniques to monitor these changes is presented for two specific regions: (1) the Perris Valley surrounding the future Lake Perris; and (2) the Sheep Creek Fan-Mirage Basin area of the Mojave Desert. Author

N73-21357* California Univ., Berkeley.

COASTAL ZONE AND RIVER DELTA STUDIES

In its An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Tech. 1 Feb. 1971 18 p

CSSL 08H

Remote sensing techniques are proposed for the development of a California coastal land use classification system which depicts and reflects essential parameters of environmental conditions and quality. Included in the earth resources survey is the Sacramento-San Joaquin River Delta and its complex hydrologic system which links saline waters of the San Francisco Bay with the Central Valley watershed. G.G.

N73-21361*# South Dakota State Univ., Brookings. Remote Sensing Inst.

MONITORING FLOOD DAMAGE WITH SATELLITE IMAGERY Interim Report

L. A. Benson and F. A. Waltz Mar. 1973 15 p refs

(Grant NGL-42-003-007)

(NASA-CR-131641; NASA-RSI-73-07) Avail: NTIS HC \$3.00 CSSL 08H

During analysis of ERTS-1 imagery for land use patterns a large impoundment of water was observed in a location that was normally farmland. Subsequent investigation revealed that the satellite had recorded the remaining floodwaters from a severe local rainstorm that had occurred four days prior to the overpass. The inundated area was measured using the automatic planimeter associated with the signal analysis and dissemination equipment located at the Remote Sensing Institute. The area measurement coupled with estimates of the land use and productivity of the region permitted an estimate of the crop damage loss for the inundated area. Author

N73-22282*# American Univ., Washington, D.C.

ERTS-1 DATA USER INVESTIGATION OF WETLANDS ECOLOGY Progress Report

Richard R. Anderson, Principal Investigator 16 Apr. 1973 5 p ERTS

(Contract NAS5-21752)

(E73-10507; NASA-CR-131545; PR-5) Avail: NTIS HC \$3.00 CSSL 08H

The author has identified the following significant results. ERTS-1 imagery (enlarged to 1:250,000) is an excellent tool by which large area coastal marshland mapping may be undertaken. If states can sacrifice some accuracy (amount unknown at this time) in placing of boundary lines, the technique may be used

to do the following: (1) estimate extent of man's impact on marshes by ditching and lagooning and accelerated successional trends; (2) place boundaries between wetland and upland and hence estimate amount of coastal marshland remaining in the state; (3) distinguish among relatively large zones of various plant species including high and low growth *S. alterniflora*, *J. roemerianus*, and *S. cynosuroides*; and (4) estimate marsh plant species productivity when ground based information is available.

N73-23408* Southern Great Plains Watershed Research Center, Chickasha, Okla.
USE OF SPACE DATA IN WATERSHED HYDROLOGY
 Progress Report, 10 Nov. 1972 - 10 Mar. 1973
 Bruce Blanchard, Principal Investigator 10 Mar. 1973 4 p ERTS
 (NASA Order S-70251-AG-4)
 (E73-10513; NASA-CR-131471) Avail: NTIS HC \$3.00 CSCI 08H

N73-23409* Delaware Univ., Newark. Coll. of Marine Studies.
SATELLITE STUDIES OF SUSPENDED MATTER AND AQUATIC INTERFACES IN DELAWARE BAY
 V. Klemas, Principal Investigator, R. Srna, and W. Treasure 22 Feb. 1973 2 p ERTS
 (Contract NAS5-21837)
 (E73-10515; NASA-CR-131476) Avail: NTIS HC \$3.00 CSCI 08C

The author has identified the following significant results. Three successful ERTS-1 satellite passes have produced synoptic imagery showing distribution of suspended matter and aquatic interfaces over Delaware Bay and adjacent Atlantic coastal regions. The interfaces are a major hydrographic feature in Delaware Bay and frequently include regions of high convergence. In the upper and middle bay the interfaces tend to align along the flow axis of the river and parallel to the shoreline. A correlation has been found between the concentration of sand particles in suspension and the depth, suggesting that most of the heavier particles are lifted into temporary suspension over shoals and shallow areas by currents and waves. The second type of interface is primarily a tidal intrusion of shelf water into the bay during incipient flood tide, with associated discontinuities in salinity and temperature. The convergence properties of such fronts attract heavy accumulations of foam which were found to contain strong concentrations of heavy metals and other toxic substances.

N73-23412* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
DETECTING CHANGES IN WATER QUALITY AND SURFACE AREA IN TAHOKA LAKE, LYNN COUNTY TEXAS, USING SEQUENTIAL ERTS MSS DATA
 Marion F. Baumgardner, Principal Investigator 16 Mar. 1973 1 p ERTS
 (Contract NAS5-21785)
 (E73-10518; NASA-CR-131481) Avail: NTIS HC \$3.00 CSCI 08H

N73-23422* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
A STUDY OF THE UTILIZATION OF ERTS-1 DATA FROM THE WABASH RIVER BASIN Bimonthly Progress Report
 D. A. Landgrebe, Principal Investigator 30 Apr. 1973 8 p ERTS
 (Contract NAS5-21773)
 (E73-10549; NASA-CR-131653) Avail: NTIS HC \$3.00 CSCI 08B

The author has identified the following significant results. For the urban land use analysis project, classification results were good to excellent for the following classes: single family residential, commercial/industrial, cloud, cloud shadow, trees, and water. Grassy areas were defined fairly well, but residential areas located between multi-family residential and single-family residential were misclassified as grassy. Residential areas dominated by tree cover, termed wooded residential, were unable

to be classified in a single class. Data points in such areas were classified randomly as either grassy or trees.

N73-23431* Geological Survey, Tacoma, Wash.
EVALUATE ERTS IMAGERY FOR MAPPING AND DETECTION OF CHANGES OF SNOWCOVER ON LAND AND ON GLACIERS Progress Report, 1 Mar. - 30 Apr. 1973
 Mark F. Meier, Principal Investigator 30 Apr. 1973 4 p ERTS
 (NASA Order S-70243-AG-2)
 (E73-10559; NASA-CR-131858) Avail: NTIS HC \$3.00 CSCI 08B

The author has identified the following significant results. A possibly more accurate method to determine snowcover area change has been tried; snowcover area change over periods of an ERTS-1 cycle are very useful in determining energy balances over regional areas and to determine snow depth as a function of altitude. Also since shadow and cloud cover areas are highlighted this method may be a step toward more complete machine processing.

N73-23433* Nevada Univ., Reno. Mackay School of Mines.
[SPECTRAL REFLECTANCE MEASUREMENTS OF PLAYA LAKES] Progress Report, 1-30 Apr. 1973
 Jack Quade, Principal Investigator 30 Apr. 1973 2 p EREP
 (Contract NAS9-13274)
 (E73-10561; NASA-CR-131880) Avail: NTIS HC \$3.00 CSCI 08H

N73-23445* Corps of Engineers, Waltham, Mass.
THE USE OF ERTS IMAGERY IN RESERVOIR MANAGEMENT AND OPERATION Progress Report, 14 Feb. - 14 Apr. 1973
 Saul Cooper and Paul Bock, Principal Investigators 21 May 1973 12 p ERTS
 (NASA Order S-70256-AG)
 (E73-10585; NASA-CR-131901) Avail: NTIS HC \$3.00 CSCI 08H

N73-23446* Zurich Univ. (Switzerland). Dept. of Geography.
SNOW SURVEY AND VEGETATION GROWTH IN HIGH MOUNTAINS (SWISS ALPS) Progress Report
 Harold Haefner, Principal Investigator [1973] 14 p Sponsored by NASA ERTS
 (E73-10586; NASA-CR-131902) Avail: NTIS HC \$3.00 CSCI 08L

The author has identified the following significant results. A method for mapping snow over large areas was developed combining the possibilities of a Quantimet (QTM 72) to evaluate the exact density level of the snow cover for each individual image (or a selected section of the photo) with the higher resolution of photographic techniques. The density level established on the monitor by visual control is used as reference for the exposure time of a lithographic film, producing a clear tonal separation of all snow- and ice-covered areas from uncovered land in black and white. The data is projected onto special maps 1:500,000 or 1:100,000 showing the contour lines and the hydrographic features only. The areal extent of the snow cover may be calculated directly with the QTM 720 or on the map. Bands 4 and 5 provide the most accurate results for mapping snow. Using all four bands a separation of an old melting snow cover from a new one is possible. Regional meteorological studies combining ERTS-1 imagery and conventional sources describe synoptical evolution of meteorological systems over the Alps.

N73-23466* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ERTS-1 APPLICATIONS IN HYDROLOGY AND WATER RESOURCES
 V. V. Salomonson and A. Rango May 1973 25 p refs Presented at 93d Ann. Conf. of the Am. Water Works Assoc., 13-18 May 1973
 (NASA-TM-X-66237; X-650-73-131) Avail: NTIS HC \$3.25

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CSSL 08H

After having been in orbit for less than one year, the Earth Resources Technology Satellite (ERTS-1) has shown that it provides very applicable data for more effective monitoring and management of surface water features over the globe. Mapping flooded areas, snowcover, and wetlands and surveying the size, type, and response of glaciers to climate are among the specific areas where ERTS-1 data were applied. In addition the data collection system has proven to be a reliable tool for gathering hydrologic data from remote regions. Turbidity variations in lakes and rivers were also observed and related to shoreline erosion, industrial plant effluent, and overall water quality. Author

N73-23479*# Colorado State Univ., Fort Collins. A FEASIBILITY STUDY OF USING REMOTELY SENSED DATA FOR WATER RESOURCE MODELS

James F. Ruff Feb-1973 35 p refs

(Contract NAS8-28590)

(NASA-CR-129001) Avail: NTIS HC \$3.75 CSSL 08H

Remotely sensed data were collected to demonstrate the feasibility of applying the results to water resource problems. Photographs of the Wolf Creek watershed in southwestern Colorado were collected over a one year period. Cloud top temperatures were measured using a radiometer. Thermal imagery of the Wolf Creek Pass area was obtained during one pre-dawn flight. Remote sensing studies of water resource problems for user agencies were also conducted. The results indicated that: (1) remote sensing techniques could be used to assist in the solution of water resource problems; (2) photogrammetric determination of snow depths is feasible; (3) changes in turbidity or suspended material concentration can be observed; and (4) surface turbulence can be related to bed scour; and (5) thermal effluents into rivers can be monitored. Author

N73-23512# Massachusetts Univ., Amherst. Water Resources Research Center.

AN INVENTORY OF THE PONDS, LAKES AND RESERVOIRS OF MASSACHUSETTS, BERKSHIRE AND FRANKLIN COUNTIES

James A. McCann and Leo M. Dely 1972 142 p refs Sponsored by Bur. of Sport Fisheries and Wildlife (OWRR Proj. A-034-Mass(1))

(PB-214116/8; Pub-10-2; W73-04089; MCFU-Contrib-26) Avail: NTIS HC \$3.00 CSSL 08H

The report is an inventory of the physical, biological and land-water use characteristics of all ponds, lakes, and reservoirs over 5 acres or identified on U.S. Geological Survey topographic maps of Berkshire and Franklin Counties, Massachusetts. Data from published sources or from official files of Federal, state and regional water resources agencies were summarized, recorded on standard forms, coded, and keypunched on automatic data processing cards. The physical characteristics of the ponds were updated to include all standing bodies of water over 5 acres located on aerial photographs taken in the spring of 1965.

Author (GRA)

N73-24349* Environmental Research Inst. of Michigan, Ann Arbor.

LAKE ICE SURVEILLANCE; TASK 4

M. Leonard Bryan, Principal Investigator *In its* ERTS-1 Invest. conducted by Environ. Res. Inst. of Mich. 9 May 1973 1 p ERTS

(E73-10569) CSSL 08L

N73-24381* Environmental Research Inst. of Michigan, Ann Arbor.

IFYGL (LAKE ONTARIO), TASK 6

F. C. Polcyn, Principal Investigator *In its* ERTS-1 Invest. conducted by Environ. Res. Inst. of Mich. 9 May 1973 1 p ERTS

(E73-10571) CSSL 08H

N73-24356*# Stanford Research Inst., Menlo Park, Calif. STUDY OF TIME LAPSE DATA PROCESSING FOR DYNAMIC HYDROLOGIC CONDITIONS Progress Report, 6 Mar. - 6 May 1973

Sidney M. Serebreny, Principal Investigator 6 May 1973 11 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21841)

(E73-10582; NASA-CR-131898) Avail: NTIS HC \$3.00 CSSL 08H

N73-24359*# Texas Technological Univ., Lubbock. Remote Sensing Lab.

DYNAMICS OF PLAYA LAKES IN THE TEXAS HIGH PLAINS Progress Report, 1 Apr. - 31 May 1973

C. C. Reeves, Jr., Principal Investigator 31 May 1973 6 p ERTS

(Contract NAS5-21720)

(E73-10598; NASA-CR-131994) Avail: NTIS HC \$3.00 CSSL 08H

N73-24380*# Geological Survey, Arlington, Va. DYNAMICS OF SUSPENDED SEDIMENT PLUMES IN LAKE ONTARIO Progress Report, 1 Mar. - 30 Apr. 1973

Edward J. Pluhowski, Principal Investigator 1 May 1973 3 p ERTS

(NASA Order 8-70243-AG-2)

(E73-10599; NASA-CR-131995) Avail: NTIS HC \$3.00 CSSL 08H

N73-24364*# Delaware Univ., Newark.

DYNAMICS OF PLANKTON POPULATIONS IN UPWELLING AREAS

Karl-Heinz Szekields, Principal Investigator May 1973 11 p ERTS

(Contract NAS5-21784)

(E73-10603; NASA-CR-131999) Avail: NTIS HC \$3.00 CSSL 08A

N73-24374*# Tulane Univ., New Orleans, La.

PRELIMINARY STUDY OF LAKE PONTCHARTRAIN AND VICINITY USING REMOTELY SENSED DATA FROM THE ERTS-A SATELLITE Progress Report

John U. Hoidal, Principal Investigator, Alfred E. Smalley, Kenneth H. Faller, and Mary B. Irvin 15 May 1973 8 p ERTS

(Contract NAS5-21740)

(E73-10613; NASA-CR-132010) Avail: NTIS HC \$3.00 CSSL 08H

The author has identified the following significant results. During the summer of 1972, huge mats of duckweeds (Lemnaceae) appeared on Lake Pontchartrain, a shallow estuary in southeastern Louisiana. In color infrared photography, duckweeds show a characteristic light lavender color, unlike algal mats or water hyacinth, as observed in low level aerial photography. Although at least five species are present in the area, most water coverage is by *Lemna minor* and *Spirodela oligorrhiza*. ERTS-1 imagery shows many areas of bayous, swamps, and marginal waters of Lake Pontchartrain covered with duckweeds. Subsequent passes show a seasonal decreases in duckweeds.

N73-24380*# Alaska Univ., Fairbanks.

BREAK-UP CHARACTERISTICS OF CHENA RIVER BASIN Bimonthly Progress Report

Robert F. Carlson, Principal Investigator 31 May 1973 4 p ERTS

(Contract NAS5-21833)

(E73-10619; NASA-CR-132030; BMPR-5) Avail: NTIS HC \$3.00 CSSL 08H

The author has identified the following significant results. Utilization of the Zoom transfer scope enabled the plotting of

the snow conditions on topographical maps and the transferring of the contour lines onto the aerial photographs, so that the snow conditions could be studied for dependence and exposure.

N73-24387*# Geological Survey, Hartford, Conn.
ESTUARINE AND COASTAL WATER DYNAMICS CONTROLLING SEDIMENT MOVEMENT AND PLUME DEVELOPMENT IN LONG ISLAND SOUND Progress Report, 1 Mar. - 30 Apr. 1973

Frederick H. Ruggles, Jr., Principal Investigator 1 May 1973 2 p ERTS
(NASA Order S-70243-AG-3)
(E73-10627; NASA-CR-132038) Avail: NTIS HC \$3.00 CSCL 08H

N73-24396*# Alaska Univ., Fairbanks.
SURVEY OF THE SEASONAL SNOW COVER IN ALASKA Bimonthly Progress Report
Gunter Weller, Principal Investigator 31 May 1973 3 p ERTS
(Contract NAS5-21833)
(E73-10637; NASA-CR-132096; BMPR-5) Avail: NTIS HC \$3.00 CSCL 08L

N73-24454# Alaska Univ., College. Inst. of Arctic Environmental Engineering.
BACKSCATTER MILLIMETER WAVES FROM SNOW, ICE AND SEA ICE Final Technical Report, 1 Jun. 1971 - 31 Dec. 1972
William M. Sackinger and Robert C. Byrd 31 Dec. 1972 78 p refs
(Contract N00014-71-A-0365-0001; ARPA Order 1783)
(AD-758071; IAE-7207) Avail: NTIS CSCL 08/12

The factors contributing to the scattering of electromagnetic waves from snow, ice, and sea ice are discussed. Laboratory measurements of the complex permittivity of sea ice as a function of temperature and salinity are reported for the frequency range 26-40 GHz. Bistatic field measurements of backscatter are also described, and results presented for a wide variety of conditions of snow cover and ice topography. Surface topography and liquid water content are dominant contributors to backscatter.

Author (GRA)

N73-25348*# Geological Survey, Nashville, Tenn.
INVESTIGATION OF BASIN CHARACTERISTICS EXTRACTED FROM ERTS DATA FOR IMPROVING REGRESSION ESTIMATES OF STREAMFLOW Progress Report, 1 Sep. - 31 Oct. 1972
Este F. Hollyday, Principal Investigator 1 Nov. 1972 3 p ERTS
(NASA Order S-70243-AG-2)
(E73-10652; NASA-CR-132243) Avail: NTIS HC \$3.00 CSCL 08H

N73-25350*# Maine Dept. of Transportation, Augusta.
TO DEVELOP A LAND USE, PEAK RUNOFF CLASSIFICATION SYSTEM FOR HIGHWAY ENGINEERING PURPOSES Interim Report, Jan. - Jun. 1973
Ernest G. Stoeckeler, Principal Investigator 1 Jun. 1973 5 p ERTS
(Contract NAS5-21724)
(E73-10654; NASA-CR-132245) Avail: NTIS HC \$3.00 CSCL 08B

N73-25362*# Maine Dept. of Transportation, Augusta.
MAP THE DISTRIBUTION OF GLACIOFLUVIAL DEPOSITS AND ASSOCIATED GLACIAL LANDFORMS Interim Report, Nov. 1972 - May 1973
Raymond G. Woodman, Principal Investigator May 1973 8 p ERTS
(Contract NAS5-21747)
(E73-10667; NASA-CR-132178) Avail: NTIS HC \$3.00 CSCL 08L

N73-25367*# National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, Tex.
UTILIZATION OF ERTS-1 DATA IN THE HOUSTON AREA
R. Bryan Erb, Principal Investigator 12 Mar. 1973 2 p ERTS
(E73-10672; NASA-TM-X-69261) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. Using clustering techniques, several large lakes in Texas have been accurately delineated in computer printout graymaps. It was also found that small bodies of water (one to two acres in size) could be detected by searching for small reflectance values in the infrared data. A graymap printout of a lake described a shore outline that was not consistent with available maps. Field examination revealed that the actual level of the lake was below that for which the map was drawn. The current lake configuration agrees in shape and relative size with the ERTS-1 data printout. Water turbidity causes reflectance changes which are detectable in ERTS-1 band 7 data. A comparison has been made of the Monterey Bay, California area using 1971 aerial color infrared photography and a 1972 ERTS-1 band 7 infrared image. This comparison revealed that some event has occurred to impound a significant amount of water in the area since the infrared photography was taken. Data values in the ERTS-1 infrared image exhibit detectable changes in brightness at inflow points, where high turbidity would be present. Researchers had not expected to detect water turbidity patterns in band 7 (800 to 1100 nanometers).

N73-25368*# National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, Tex.
DETECTION OF SMALL PONDS ON ERTS-1 IMAGERY
R. Bryan Erb, Principal Investigator 20 Mar. 1973 1 p ERTS
(E73-10673; NASA-TM-X-69262) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. It has been determined that ponds within forested areas as small as one hectare (2.5 acres) are detectable from the ERTS-1 data. This finding was made from the analysis of scene #1037-16244 on 29 August 1972 over the Sam Houston National Forest in Walker County, Texas. These ponds were identified on the 9 inch B/W transparencies magnified seven times in areas of contrast ratios in a range of 1:1.2 to 1:2.0.

N73-25370*# National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, Tex.
AN OBJECTIVE TECHNIQUE TO ESTIMATE PERCENTAGE OF AN ERTS-1 WATER BOUNDARY RESOLUTION ELEMENT COVERED BY WATER
R. Bryan Erb, Principal Investigator [1973] 1 p ERTS
(E73-10675; NASA-TM-X-69264) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. An objective technique was developed to measure the surface area of water bodies. Nineteen water bodies in the Houston and Galveston, Texas area were selected as a basis for the technique development. The actual surface area of each body was determined from rectified and enlarged NASA aircraft photography. A clustering algorithm was used to produce classification maps of the region from ERTS-1 data. Certain classes were identified as being 100% water. Other classes were identified as being mixtures of water with land or vegetation. The number of picture elements falling on each water body and its boundary were counted. A linear regression analysis was performed to relate the total number of picture elements and boundary elements counted to the actual surface area. The standard error of the estimate was 6.7 acres. The absolute error was not a function of the actual surface area of the water body.

N73-25378*# Delaware Univ., Newark. Coll. of Marine Studies.
DYNAMICS OF PLANKTON POPULATIONS IN UPWELLING AREAS
Karl-Heinz Sekiela, Principal Investigator Oct. 1972 17 p ERTS

06 HYDROLOGY AND WATER MANAGEMENT

(Contract NAS5-21784)
(E73-10683; NASA-CR-132190) Avail: NTIS HC \$3.00 CSCL 08A

N73-25414# Delaware Univ., Newark. Coll. of Marine Studies.

COASTAL VEGETATION OF DELAWARE. THE MAPPING OF DELAWARE'S COASTAL MARSHES

V. Klemas, F. C. Daiber, D. S. Bartlett, O. W. Crichton, and A. O. Fomes Mar. 1973 32 p refs Original contains color illustrations

(Contract N00014-69-A-0407; Grants NSF GI-33369;

NOAA-2-35223)

Avail: NTIS HC \$3.75 CSCL 08F

In view of severe limitations of time and manpower, the mapping approach used relied heavily on aerial photography and multispectral analysis, utilizing conventional ground reconnaissance only to aid and check the photointerpretation. Work has shown that multispectral image analysis can significantly help, yet not replace, the human interpreter. Suitable imagery from NASA and other sources was available, and a multispectral data processing system was obtained. Author

N73-26313*# Kansas Univ. Center for Research, Inc., Lawrence.

DETECTION OF WATER BODIES IN SALINE COUNTY, KANSAS

B. G. Barr, Principal Investigator 10 May 1973 4 p ERTS (Grant NGL-17-004-024)

(E73-10684; NASA-CR-132191) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. A total of 2,272 water bodies were mapped in Saline County, Kansas in 1972 using ERTS-1 imagery. A topographic map of 1955 shows 1,056 water bodies in the county. The major increase took place in farm ponds. Preliminary comparison of image and maps indicates that water bodies larger than ten acres in area proved consistently detectable. Most water areas between four and ten acres are also detectable, although occasionally image context prevents detection. Water areas less than four acres in extent are sometimes detected, but the number varies greatly depending on image context and the individual interpreter.

N73-26314*# Alabama Univ., University.

AN INVESTIGATION TO DETERMINE THE OPTIMUM MONITORING SITES FOR PLACING ERTS DATA COLLECTION PLATFORMS IN A RIVER BASIN M.S. Thesis

Harold R. Henry, Principal Investigator and Charles Lamar Larimore 1973 112 p refs ERTS

(Contract NAS5-21876)

(E73-10689; NASA-CR-132200) Avail: NTIS HC \$7.75 CSCL 08H

N73-26335*# Stanford Research Inst., Calif.

STUDY OF TIME LAPSE PROCESSING FOR DYNAMIC HYDROLOGIC CONDITIONS Progress Report, 7 May - 6 Jul. 1973

Sidney M. Serebreny, Principal Investigator 6 Jul. 1973 7 p ERTS

(Contract NAS5-21841)

(E73-10729; NASA-CR-133073) Avail: NTIS HC \$3.00 CSCL 08H

N73-26339*# Zurich Univ. (Switzerland). Dept. of Geography. SNOW SURVEY AND VEGETATION GROWTH IN HIGH MOUNTAINS (SWISS ALPS) Progress Report

Harold Haefner, Principal Investigator [1973] 9 p refs Sponsored by NASA ERTS

(E73-10733; NASA-CR-133077) Avail: NTIS HC \$3.00 CSCL 08L

N73-26353*# National Environmental Satellite Service, Washington, D.C.

EVALUATION OF ERTS DATA FOR CERTAIN HYDROLOGICAL USES Phase 1 Report, Apr. - May 1973

Donald R. Wiesnet, Principal Investigator and David F. McGinnis May 1973 7 p

(NASA Order S-70246-AG)

(E73-10750; NASA-CR-133118) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. Melting ice has been detected in Lake Erie by comparison of visible and near infrared differential reflectance. This melting condition is confirmed by meteorological ground truth data and concurrent NOAA-2 thermal infrared data. Using near-synchronous ERTS-1 data, it was possible to determine the approximate ground resolution of NOAA-2 very high resolution radiometer by comparing the smallest identifiable ice crack in the imagery and measuring the same crack on the ERTS-1 image. It was determined that photointerpretation and analysis of a single Lake Erie image can, under certain conditions, provide meaningful data on ice dynamics. ERTS-1 imagery is effective for icepack monitoring of the Great Lakes, but the sampling interval of 18 days imposes a severe limitation. Maps of the snow cover in the American River basin for 16 March 1973 have been prepared using all four bands.

N73-26358*# Environmental Research and Technology, Inc., Lexington, Mass.

EVALUATE THE APPLICATION OF IMPROVED SPACECRAFT MEASUREMENTS FOR SNOW COVER SURVEY USING SKYLAB/EREP DATA Quarterly Progress Report,

14 Mar. - 14 Jun. 1973

Timothy T. White, Principal Investigator 20 Jun. 1973 3 p EREP

(Contract NAS9-13305)

(E73-10755; NASA-CR-133123; ERT-P-412-3; QPR-1) Avail: NTIS HC \$3.00 CSCL 08L

N73-26367*# Scientific Translation Service, Santa Barbara, Calif.

USE OF SPACE IMAGES FOR GLACIER INVESTIGATIONS IN MOUNTAINOUS REGIONS

V. I. Kravtsova and I. A. Labutina Washington NASA Jul. 1973 32 p refs Transl. into ENGLISH of "Ispolzovaniye Kosmicheskikh Snimkov dlya Glyatsiologicheskogo Izucheniya Gornyykh Rayonov", Acad. of Sci. USSR, Inst. of Space Res., Moscow, report, 1973 30 p Presented at Meeting of the Soviet-Am. Working Group on Remote Sensing of Nat. Environment from Space, Moscow, 12-17 Feb. 1973

(Contract NASw-2483)

(NASA-TT-F-14969) Avail: NTIS HC \$3.75 CSCL 08L

The use of space imagery to study glaciological objects, and in particular the snow and glacier complexes in mountains, is discussed. It is shown that orbital photographic pictures have higher ground resolution and may be used to study glaciers. Author

N73-27235*# Mississippi Test Facility, Bay St. Louis.

EVALUATION OF SATELLITE REMOTE SENSING AND AUTOMATIC DATA TECHNIQUES FOR CHARACTERIZATION OF WETLANDS AND MARSHLANDS Progress Report

Robert H. Cartmill, Principal Investigator 3 Jul. 1973 2 p ERTS

(E73-10740; NASA-TM-X-69168) Avail: NTIS HC \$3.00 CSCL 08H

N73-27236*# Calspan Corp., Buffalo, N.Y.

S190 INTERPRETATION TECHNIQUES DEVELOPMENT AND APPLICATION TO NEW YORK STATE WATER RESOURCES Quarterly Report, 6 Mar. - 31 May 1973

Kenneth R. Piech, Principal Investigator 31 May 1973 6 p
refs EREP
(Contract NAS9-13336)
(E73-10744; NASA-CR-133112; QR-1) Avail: NTIS HC
\$3.00 CSCL 08H

There are no author-identified significant results in this report.

N73-27244* Kansas Univ. Center for Research, Inc., Lawrence.

GRID MANAGEMENT OF SMALL WATER BODIES

H. L. Yarger, Principal Investigator 8 Feb. 1973 5 p ERTS
(Contract NAS5-21822)
(E73-10768; NASA-CR-133135) Avail: NTIS HC \$3.00 CSCL
08H

N73-27247* Vermont Univ., Burlington. Remote Sensing Lab.

SURVEY OF LAKE FLOODING FROM ERTS-1: LAKE CHAMPLAIN

Aulis O. Lind, Principal Investigator Jun. 1973 11 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57189 ERTS

(Contract NAS5-21753)

(E73-10771; NASA-CR-133138) Avail: NTIS HC \$3.00 CSCL
08H

The author has identified the following significant results. ERTS-1 imagery showing seasonal lake-level conditions in Lake Champlain can be used to assess shoreline change and flooding extent. MSS bands 6 and 7 provide maximum land-water contrasts and are the most useful for shoreline location. Shoreline changes observed between ERTS coverages of October 10 (low water) and April 7 and 25 (high water) are readily apparent and enlargement of specific scenes by a factor of four provides data which can be transferred to a map base. The unique synoptic view provided by ERTS-1 will make it possible to map shoreline positions occurring at a specific lake stage. Due to present government concerns over abnormally high lake levels, resource management questions have been raised regarding the extent, nature, and occurrence of inundation magnitude of shoreline change, and lake volume change.

N73-27253* Water Survey of Canada, Ottawa (Ontario). DATA RETRANSMISSION FROM WATER SURVEY OF CANADA GAUGING STATIONS USING THE ERTS DATA COLLECTION SYSTEM

R. A. Halliday, Principal Investigator 9 Jul. 1973 7 p Presented at ERTS-1 Data Collection Workshop, Wallops Station, Va., 30-31 May 1973 Sponsored by NASA ERTS
(E73-10777; NASA-CR-133144) Avail: NTIS HC \$3.00 CSCL
08H

N73-27271* Delaware Univ., Newark.

DYNAMICS OF PLANKTON POPULATIONS IN UPWELLING AREAS

Karl-Heinz Szekiolda, Principal Investigator Jul. 1973 81 p
refs ERTS

(Contract NAS5-21784)

(E73-10795; NASA-CR-133187) Avail: NTIS HC \$5.25 CSCL
08A

N73-27281* Vermont Univ., Burlington. Remote Sensing Lab.

ICE DEVELOPMENT ON LAKE CHAMPLAIN

A. O. Lind, Principal Investigator Jul. 1973 5 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21753)

(E73-10806; NASA-CR-133290) Avail: NTIS HC \$3.00 CSCL

08L

The author has identified the following significant results. Only one usable ERTS-1 scene was available for lake ice survey of Lake Champlain. The January 8, 1973, coverage (image no. 1169-11521) revealed the presence of various ice tones, patterns, and arrangements as well as open water. MSS band 5 imagery provided the most useful data. While it was not possible to differentiate open water from one - two day old ice, which only occurred over a small portion of the lake area, it was possible to interpret the tonal signatures of the frozen portion in terms of freezing history or age. The dark gray-tones of new, smooth ice contrasts with the medium gray-tones of older ice, and the rough texture of wind-jammed bay ice. Mapping of these patterns seems quite feasible with moderate enlargement of the scene (2 to 3X).

N73-27293* Texas Univ., Austin. Dept. of Geological Sciences.

STREAM NETWORK ANALYSIS FROM ORBITAL AND SUB-ORBITAL IMAGERY Quarterly Progress Report

Victor R. Baker, Principal Investigator 24 Jul. 1973 4 p
ERE

(Contract NAS9-13312)

(E73-10818; NASA-CR-133312) Avail: NTIS HC \$3.00 CSCL
08H

N73-27302* Texas Technological Univ., Lubbock. Remote Sensing Lab.

DYNAMICS OF PLAYA LAKES IN THE TEXAS HIGH PLAINS Progress Report, 1 Jun. - 31 Jul. 1973

C. C. Reeves, Jr., Principal Investigator 31 Jul. 1973 5 p
ERTS

(Contract NAS5-21720)

(E73-10832; NASA-CR-133337) Avail: NTIS HC \$3.00 CSCL
08H

N73-27303* Environmental Research and Technology, Inc., Lexington, Mass.

USE OF ERTS DATA FOR MAPPING SNOW COVER IN THE WESTERN UNITED STATES Progress Report, 1 Jan. - 30 Jun. 1973

James C. Barnes, Principal Investigator, Clinton J. Bowley, and David A. Simmes Jul. 1973 34 p ERTS

(Contract NAS5-21803)

(E73-10833; NASA-CR-133338) Avail: NTIS HC \$3.75 CSCL
08L

The author has identified the following significant results. Data have been analyzed primarily for two test sites, the central Arizona mountains and the southern Sierra Nevada in California. The results of the data analysis completed indicate that snow extent can be mapped from ERTS-1 imagery in more detail than is depicted on aerial survey snow charts. For the areas tested, the agreement between the percentage snow cover as determined from ERTS-1 data and from aerial survey snow charts is of the order of 5% for most cases. Moreover, it appears that although small details in the snowline can be mapped better from higher resolution aircraft photographs, boundaries of the areas of significant snow cover can be mapped as accurately from the ERTS-1 imagery as from the aircraft photography.

N73-27305* Wisconsin Univ., Milwaukee. Air Pollution Analysis Lab.

THE USE OF ERTS-1 SATELLITE DATA IN GREAT LAKES MESOMETEOROLOGICAL STUDIES Progress Report

Walter A. Lyons, Principal Investigator 30 Apr. 1973 35 p
refs ERTS

(Contract NAS5-21736)

(E73-10835; NASA-CR-133340) Avail: NTIS HC \$3.75 CSCL
04B

The author has identified the following significant results. A remarkable view of particulate air pollution was discovered in

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the vicinity of Buffalo, New York, on 20 June 1973. There was a classic all-shore lake breeze in progress, and it was obvious that dense smoke was present to the west of Buffalo over Lake Erie. This smoke was the pollution that had been produced by sources in the area which had been undercut by the inland rushing lake breeze front and which was then being advected lakewards in the return flow layer aloft. It is precisely this phenomena, the recirculation of pollutants in the lake breeze, that is the object of the full-scale EPA support field project being directed by the University of Wisconsin-Milwaukee in the summer of 1973.

N73-27322# National Oceanic and Atmospheric Administration, Rockville, Md.

INTERNATIONAL FIELD YEAR FOR THE GREAT LAKES
Joseph MacDowall Sep. 1972 124 p refs Jointly sponsored by Can. and US Natl. Comm. for Intern. Hydrological Decade (IFYGL-BULL-4) Avail: NTIS HC \$8.25

The findings of the International Field Year for the Great Lakes are presented. The subjects discussed are: (1) atmospheric water balance, (2) remote sensing, (3) micrometeorological project, (4) radar observing and data processing system, (5) Canadian data management procedures, and (6) thermal structure and heat content of Lake Ontario. Author

N73-28245* Wyoming Univ., Laramie.
GLACIATION OF NORTHWESTERN WYOMING INTERPRETED FROM ERTS-1

Roy M. Breckenridge *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 363-369 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-G14) CSCL 08L

Analysis of ERTS Imagery has shown a number of alpine glacial features can be recognized and mapped successfully. Although the Wyoming mountains are generally regarded as the type locality for Rocky Mountain glaciation some areas have not been studied from a glacial standpoint because of inaccessibility or lack of topographic control. ERTS imagery provides an excellent base for this type of regional geomorphic study. A map of maximum extent of Wisconsin Ice, flow directions and major glacial features was compiled from interpretation of the ERTS imagery. Features which can be mapped are large moraines, outwash fans and terraces. Present-day glaciers and snowfields are easily discriminated and mapped. Glaciers and glacial deposits which serve as aquifers play a significant role in the hydrologic cycle and are important because of the increasing demand placed on our water resources. ERTS provides a quick and effective method for change detection and inventory of these vital resources. Author

N73-28277* American Univ., Washington, D.C. Dept. of Biology.

DIGITAL ANALYSIS OF POTOMAC RIVER BASIN ERTS IMAGERY: SEDIMENTATION LEVELS AT THE POTOMAC-ANACOSTIA CONFLUENCE AND STRIP MINING IN ALLEGHENY COUNTY, MARYLAND

J. S. Schubert and N. H. MacLeod *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 659-664 ERTS

(Paper-E13) CSCL 08H

Two simple algorithms for classification of sedimentation levels in water and for delineation of active strip mines are in use as part of the development of a more general resource management information system. ERTS MSS CCT's are processed so that each pixel in each channel is geographically referenced and can be accessed individually during whole frame, multi-channel analysis or partial frame analysis. The sedimentation analysis clearly separates classes representing the turbid Anacostia water,

the less disturbed Potomac (really), and mud flats resulting from effluent of a major sewage treatment plant. Mud flats of organic or mineral origin are easily distinguished. Author

N73-28281* Geological Survey, Washington, D.C.
HYDROGEOLOGY OF CLOSED BASINS AND DESERTS OF SOUTH AMERICA, ERTS-1 INTERPRETATIONS

George E. Stoertz and William D. Carter *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 695-705 refs ERTS

(Paper-W1) CSCL 08H

Images from the Earth Resources Technology Satellite (ERTS-1) contain data useful in studies of hydrogeology, geomorphology, and paleoclimatology. Sixteen Return Beam Vidicon (RBV) images and 15 Multi-Spectral Scanner (MSS) images were studied. These covered deserts and semidesert areas in southwestern Bolivia, northwestern Argentina, northern Chile, and southeastern Peru from July 30 to November 17, 1972. During the first 3 months after launching, high-quality cloud-free imagery was obtained over approximately 90 percent of the region of interior drainage, or an area of 170,000 square miles. Author

N73-28282* Polytechnical Univ. of Madrid (Spain).
DETECTION OF MAJOR RIVER BED CHANGES IN THE RIVER EBRO (NORTH-EASTERN SPAIN)

R. Espejo, J. Torrent, and C. Roquero *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 707-711 ref Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-W2) CSCL 08H

The application of ERTS-1 data to determine the major river bed changes of the Ebro River in northeastern Spain is discussed. Image quality was good enough to permit a clear identification of the river course and bands MSS 5 and 7 proved to be the most useful for this purpose. Reflectance for band 5 was high due to the high sediment content of the water and sufficed to identify the river. Features like bodies of water related to old channels and depressions were only apparent in band 7. Author

N73-28283* Mekong Committee Secretariat, Bangkok (Thailand).

APPLICATIONS OF MULTISPECTRAL IMAGERY TO WATER RESOURCES DEVELOPMENT PLANNING IN THE LOWER MEKONG BASIN (KHMER REPUBLIC, LAOS, THAILAND AND VIET-NAM)

William J. vanKiere *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 713-741 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-W3)

The use of ERTS imagery for water resources planning in the lower Mekong Basin relates to three major issues: (1) it complements data from areas, which have been inaccessible in the past because of security; this concerns mainly forest cover of the watersheds, and geological features, (2) it refines ground surveys; this concerns mainly land forms, and soils of existing and planned irrigation perimeters, and (3) it provides new information, which would be almost or entirely impossible to detect with ground surveys or conventional photography; this concerns the mechanism of flooding and drainage of the delta; siltation of the Great Lake and mapping of acidity, possibly also of salinity, in the lower delta; sedimentation and fisheries in the Mekong Delta estuarine areas. Author

N73-28284* Geological Survey, Denver, Colo.
ASSESSMENT OF FLOOD DAMAGE IN ARIZONA BY MEANS OF ERTS-1 IMAGERY

Roger B. Morrison and Maurice E. Cooley *In* NASA. Goddard

Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 755-760 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-W6)

ERTS-1 MSS images clearly show two important effects of a large flood in southeastern Arizona - the extent of inundation and the areas affected by severe sediment deposition and erosion - although the images were made a week and a half after the flood. On October 20 and 21, 1972, the upper Gila River had its third-largest flood on record. Peak flows attained about 42,000 and 82,000 cubic feet a second at Duncan and Safford, Arizona, respectively. The first ERTS-1 images after the flood were made on November 1 and 2. The inundated area is best displayed on the infrared bands, particularly on band 7, where it appears as a belt along the river that is distinctly darker than adjoining parts of the flood plain. This dark belt does not appear on ERTS images that predate the flood. Presumably the low infrared reflectance of this belt is caused by still-moist soil and by flood-stressed vegetation. Inundation limits mapped from ERTS imagery agree well with those obtained by aerial photography during the flood and by ground surveys.

Author

N73-28286* Geological Survey, Phoenix, Ariz. Water Resources Div.

MONITORING OF STREAMFLOW IN THE VERDE RIVER BY ERTS-1 DATA COLLECTION SYSTEM (DCS)

Herbert H. Schumann / In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 769-776 ERTS

(Paper-W8)

The Verde River watershed in central Arizona furnishes municipal, industrial, and agricultural water to the Salt River Valley -- an area that contains more than half of Arizona's population and about one-fourth of the State's irrigated land. Water-management decisions related to the operation of large multiple-use reservoirs require accurate and continuous monitoring of moisture conditions over large remote areas. The U.S. Geological Survey in cooperation with the Salt River Valley Water Users' Association installed a specially designed gaging station on the Verde River near the town of Camp Verde to evaluate near-real time streamflow data furnished by the ERTS-1 Data Collection System (DCS). On Nov. 3, 1972, the installation was equipped with a Stevens digital water-level recorder, modified for telemetry, and an ERTS-1 data collection platform operating in the digital-parallel mode.

Author

N73-28287* Geological Survey, Harrisburg, Pa.

PRELIMINARY ANALYSIS OF ERTS-RELATED WATER RESOURCES DATA IN THE DELAWARE RIVER BASIN

Richard W. Paulson / In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Sect. A and B 1973 p 777-792 ERTS

(Paper-W10) CSCL 08H

Preliminary analysis of ERTS-DCS data from water-resources stations in the Delaware River Basin indicates that the Data-Collection System is performing well. Data-Collections Platforms have been successfully interfaced with five stream-gaging station and three ground-water observation wells and are being interfaced with 12 water-quality monitors in the basin. Data are being relayed during four or five ERTS orbital passes per day, which is within the design specifications of the ERTS-DCS.

Author

N73-28289* Environmental Research Inst. of Michigan, Ann Arbor.

PRELIMINARY EVALUATION OF ERTS-1 FOR DETERMINING NUMBERS AND DISTRIBUTION OF PRAIRIE PONDS AND LAKES

Edgar A. Work, Jr., David S. Gilmer (Bur. of Sport Fisheries and Wildlife, Jamestown, N. D.), and A. T. Klett (Bur. of Sport Fisheries

and Wildlife, Jamestown, N. D.) / In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 801-808 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-W12) CSCL 08H

ERTS-1 and aircraft multispectral data collected over a North Dakota test site during July 1972, are compared to evaluate the capability of the satellite sensors to detect numbers and distribution of prairie ponds and lakes. Recognition maps using ERTS-1, MSS 7 data are generated using a level slicing technique. Surface water areas larger than two acres are recognized, but ponds in the one-to two-acre range are detected only at random. The proportion estimation technique will improve the accuracy of area determination and small pond detection.

Author

N73-28290* Texas Technological Univ., Lubbock. Dept. of Geosciences.

DYNAMICS OF PLAYA LAKES IN THE TEXAS HIGH PLAINS

C. C. Reeves, Jr. / In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 809-817 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-W13) CSCL 08H

This study shows that satellite imagery can be used for a census of the thousands of lake basins which commonly exist in semi-arid areas, and which sporadically contain water at various times of the year. Storm paths and runoff collected by such lake basins can also be closely monitored, the accuracy dependent on periodicity of the orbits and the size of the basins. Study of the relationships between spectral differences (obtained from ERTS-1 imagery) and the water balance ecosystem of the lake basins is in a preliminary stage. However, examination of ERTS-1 MSS frames show that Band 4 has the poorest tonal contrast in semi-arid West Texas. Band 5 is best for definition of vegetation, Band 6 is best for defining larger water areas, and Band 7 is best for counting small lake basins with water. Ground-truth studies reveal significant differences between test sites, the relative importance of which will be reflected by the hydrologic balance of each lake basin.

Author

N73-28291* Guelph Univ. (Ontario).

STUDIES IN THE LAKE ONTARIO BASIN USING ERTS-1 AND HIGH ALTITUDE DATA

A. Falconer, S. H. Collins, W. T. Dickson, R. Protz, R. P. Bukata (Can. Centre for Inland Waters), K. P. B. Thomson (Can. Centre for Inland Waters), G. P. Harris (McMaster Univ.), and P. J. Howarth (McMaster Univ.) / In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 819-828 refs ERTS

(Paper-W14) CSCL 08H

Studies in the Lake Ontario Basin are designed to provide input for models of river basin discharge and macro-scale features of lake circulation. Lake studies appear to require high altitude imagery to record the dynamic features of Lake Ontario so that ERTS-1 data may be interpreted. Land area studies require input of soil moisture, land use and soil-sediment-geomorphology measurements some of which appear to be available, on a regional scale from ERTS-1 products.

Author

N73-28292* Environmental Research Inst. of Michigan, Ann Arbor.

PROGRESS OF AN ERTS-1 PROGRAM FOR LAKE ONTARIO AND ITS BASIN

Thomas W. Wagner and Fabian C. Polcyn / In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 829-836 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-W15) CSCL 08H

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The Lake Ontario drainage basin covers over 32,000 square miles of U.S. and Canadian territory. ERTS-1 data is contributing to the comprehensive study of this basin as part of the International Field Year for the Great Lakes (IFYGL). This paper details a processing approach for obtaining detailed and objective synoptic information thought to be applicable to terrestrial water balance studies of such a large area. A simple ratio algorithm was tested for minimizing daily variations in ERTS data and for allowing the discrimination of surface features and land use classes of hydrologic significance. These steps are necessary if ERTS data is to provide the quantitative information required for the study and management of areas of regional size. Author

N73-28293* Geological Survey, Arlington, Va. REMOTE SENSING OF TURBIDITY PLUMES IN LAKE ONTARIO

Edward J. Pluhowski *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 837-846 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-W16) CSCL 08H

Preliminary analyses of ERTS-1 imagery demonstrates the utility of the satellite to monitor turbidity plumes generated by the Welland Canal, and the Genesee and Oswego Rivers. Although visible in high altitude photographs, the Niagara River plume is not readily identifiable from satellite imagery. Author

N73-28294* Wisconsin Univ., Milwaukee. Air Pollution Analysis Lab.

ERTS-1 VIEWS THE GREAT LAKES

Walter A. Lyons and Steven R. Pease *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 847-854 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21736; Grants NSF GA-32208;

EPA-R-800873)

(Paper-W17) CSCL 04B

The meteorological content of ERTS images, particularly mesoscale effects of the Great Lakes and air pollution dispersion is summarized. Summertime lake breeze frontal clouds and various winter lake-effect convection patterns and snow squalls are revealed in great detail. A clear-cut spiral vortex over southern Lake Michigan is related to a record early snow storm in the Chicago area. Marked cloud changes induced by orographic and frictional effects on Lake Michigan's lee shore snow squalls are seen. The most important finding, however, is a clear-cut example of alterations in cumulus convection by anthropogenic condensation and/or ice nuclei from northern Indiana steel mills during a snow squall situation. Jet aircraft condensation trails are also found with surprising frequency. Author

N73-28295* Environmental Research and Technology, Inc., Lexington, Mass.

USE OF ERTS DATA FOR MAPPING SNOW COVER IN THE WESTERN UNITED STATES

James C. Barnes and Clinton J. Bowley *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 855-862 refs ERTS

(Paper-W18) CSCL 08L

The purpose of this investigation is to evaluate the application of ERTS data for mapping snow cover, primarily in the mountainous areas of the western United States. The specific objectives are to determine the spectral interval most suitable for snow detection, to determine the accuracy with which snow lines can be mapped in comparison with the accuracies attainable from other types of measurements, and to develop techniques to differentiate reliably between snow and clouds and to understand the effects of terrain and forest cover on snow detection. Author

N73-28296* Geological Survey, Tacoma, Wash. EVALUATION OF ERTS IMAGERY FOR MAPPING AND DETECTION OF CHANGES OF SNOWCOVER LAND AND ON GLACIERS

Mark F. Meier *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 863-875 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-W19) CSCL 08L

The percentage of snowcover area on specific drainage basins was measured from ERTS imagery by video density slicing with a repeatability of 4 percent of the snowcovered area. Data from ERTS images of the melt season snowcover in the Thunder Creek drainage basin in the North Cascades were combined with existing hydrologic and meteorologic observations to enable calculation of the time distribution of the water stored in this mountain snowpack. Similar data could be used for frequent updating of expected inflow to reservoirs. Equivalent snowline altitudes were determined from area measurements. Snowline altitudes were also determined by combining enlarged ERTS images with maps with an accuracy of about 60m under favorable conditions. Ability to map snowcover or to determine snowline altitude depends primarily on cloud cover and vegetation and secondarily on slope, terrain roughness, sun angle, radiometric fidelity, and amount of spectral information available. Author

N73-28374* Alaska Univ., Fairbanks.

SNOW COVER SURVEYS IN ALASKA FROM ERTS-1 DATA

Carl S. Benson *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1593-1595 ERTS

CSCL 08L

September and October ERTS scenes have been analyzed to delineate snow cover patterns in northern Alaska's Brooks Range and on Mt. Wrangell, and active volcano in South Central Alaska. ERTS images demonstrate that the snow on the northern foothills of the Brooks Range are significantly more affected by katabatic wind action than are the southern foothills. Aufeis deposits along arctic rivers also can be identified in late summer. A survey of such aufeis deposits could identify additional summertime sources of fresh water supplies. Images of Mt. Wrangell permit monitoring of the interaction between volcanic heat and the mass balance of glaciers that exist on active volcanoes. Temporal changes in the areas of bare rock on the rim of the caldera on the summit reveal significant melting of new snow from an extensive storm on August 18. Digital analysis of data from subsequent passes over the summit on September 7, 23 and 24 revealed considerable bare rock exposed by melting, which is virtually impossible from solar heating at this altitude and date. Author

N73-28375* Bendix Corp., Ann Arbor, Mich.

UTILIZATION OF ERTS-1 DATA TO MONITOR AND CLASSIFY EUTROPHICATION OF INLAND LAKES

Phillip E. Chase, Larry Reed, and V. Elliott Smith (Cranbrook Inst. of Sci.) *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1597-1604 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

CSCL 08H

A technique is being developed for use of ERTS in estimating and monitoring trophic levels of inland lakes. Preliminary findings are that Michigan lakes and ponds of one acre or more are resolvable in bands 5, 6 and 7 of NASA MSS imagery under fair conditions (haze and 70% cloud cover). In processed imagery (CCT) smaller features, including water color patterns, are evident within some lakes of 40 acres or more. Image distortion of lake size, shape, orientation, etc. is minimal; discrimination of lakes and ponds from various wetlands is good. Subsequent ERTS and aircraft imagery will be correlated with detailed ground truth of water color and quality in eutrophic test lakes. Author

N73-28376* National Environmental Satellite Services, Hillcrest Heights, Md.

ERTS-1 OBSERVES ALGAL BLOOMS IN LAKE ERIE AND UTAH LAKE

Alan E. Strong *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1605-1612 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

CSSL 08H

During late summer when the surface waters of Lake Erie reach their maximum temperature an algal bloom is likely to develop. Such phenomena have been noticed on other shallow lakes using ERTS-1 and characterize eutrophic conditions. The concentration of the algae into long streamers provides additional information on surface circulations. To augment the ERTS-1 MSS data of Lake Erie an aircraft was flown to provide correlative thermal-IR and additional multiband photographs. The algal bloom is highly absorptive in the visible wavelengths but reverses contrast with the surrounding water in the near-IR bands. The absorption of shortwave energy heats the dark brown algal mass, providing a hot surface target for the thermal-IR scanner. Author

N73-28395* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

APPLICATION OF ERTS-1 IMAGERY TO FLOOD INUNDATION MAPPING

George R. Hallberg (Iowa Geol. Surv., Iowa City), Bernard E. Hoyer (Iowa Geol. Surv., Iowa City), and Albert Rango *In its* Symp. on Significant Results obtained from the ERTS-1, Vol. 2 May 1973 p 51-70 refs An earlier version of this paper was published in Volume 1, pages 745-756 Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

CSSL 08B

Ground data and a variety of low-altitude multispectral imagery were acquired for the East Nishnabotna River on September 14 and 15. This successful effort concluded that a near-visible infrared sensor could map inundated areas in late summer for at least three days after flood recession. ERTS-1 multispectral scanner subsystem (MSS) imagery of the area was obtained on September 18 and 19. Analysis of MSS imagery by IGSRL, USGS, and NASA reinforced the conclusions of the low-altitude study while increasing the time period critical for imagery acquisition to at least 7 days following flood recession. The capability of satellite imagery to map late summer flooding at a scale of 1:250,000 is exhibited by the agreement of interpreted flood boundaries obtained from ERTS-1 imagery to boundaries mapped by low-altitude imagery and ground methods. Author

N73-28399* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

WATER RESOURCES

Vincent V. Salomonson and Albert Rango *In its* Symp. on Significant Results obtained from the ERTS-1, Vol. May 1973 p 115-126 Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

CSSL 08H

The application of ERTS-1 imagery to the conservation and control of water resources is discussed. The effects of existing geology and land use in the water shed area on the hydrologic cycle and the general characteristics of runoff are described. The effects of floods, snowcover, and glaciers are analyzed. The use of ERTS-1 imagery to map surface water and wetland areas to provide rapid inventorying over large regions of water bodies is reported. Author

N73-28403* California Univ., Davis.

APPLICATION OF ERTS-1 DATA TO AID IN SOLVING

WATER RESOURCES MANAGEMENT PROBLEMS IN THE STATE OF CALIFORNIA

Robert H. Burgoyne *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 2 May 1973 p 151-166 Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

CSSL 08H

Investigations within the State of California have emphasized the direct utilization of the supplemental data source afforded by the Earth Resources Technology Satellite-1 (ERTS-1) imagery. A user-oriented study has been underway for several years to identify and develop application methodology for remotely sensed information available from several platform levels, including low and high flights by NASA's U2 aircraft, and other manned and unmanned devices. The University of California has pursued both basic and applied research in remote sensing, through ongoing studies supported by NASA, and in cooperation with state agencies responsible for water resources and related fields. This report reviews the applications of ERTS-1 and supplementary imagery sources applicable to water resources planning, operations, and management. Author

N73-28410* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

WATER RESOURCES

Vincent V. Salomonson *In its* Symp. on Significant Results obtained from the ERTS-1, Vol. 3 May 1973 p 57-70 refs ERTS

CSSL 08H

Uses of ERTS-1 imagery and data for water resources surveys and management are summarized. Areas discussed are: (1) land use and geology; (2) flood plain and flood inundation mapping; (3) snow cover mapping; (4) glacier observations; (5) data collection systems; (6) surface waters; (7) wetlands mapping; (8) water quality; (9) soil mapping; (10) phreatophyte and riparian vegetation mapping; and (11) evapotranspiration. A.L.

N73-28416*# Tulane Univ., New Orleans, La. PRELIMINARY STUDY OF LAKE PONTCHARTRAIN AND VICINITY USING REMOTELY SENSED DATA FROM THE ERTS-A SATELLITE Progress Report

John U. Hidalgo, Principal Investigator, Alfred E. Smalley, Kenneth H. Feller, and Mary B. Irvin 15 Jul. 1973 6 p ERTS

(Contract NAS5-21740)

(E73-10838; NASA-CR-133398) Avail: NTIS HC \$3.00 CSSL 08H

N73-28454 Institute of Hydrology, Wallingford (England). THE APPLICATION OF MULTISPECTRAL SCANNING SYSTEMS TO HYDROLOGY

J. S. G. McCulloch and R. B. Painter *In* Plessey Radar Res. Centre Multispectral Scanning Systems and their potential Appl. to Earth Resources Surveys Apr. 1973 p 127-149 refs

Multispectral scanning (MSS) is applied to four areas of hydrology: landforms, soil moisture, water resources, and water depth and quality. Based on these studies, an experimental program is defined which would establish the feasibility of using MSS in pollution studies, measurement of soil moisture, suspended sediment, and location of freshwater springs. ESRO

N73-29213*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

A STUDY OF THE UTILIZATION OF ERTS-1 DATA FROM THE WABASH RIVER BASIN Semiannual Progress Report, 1 Jan. - 30 Jun. 1973

D. A. Landgrebe, Principal Investigator 1973 70 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21773)

(E73-10862; NASA-CR-133451) Avail: NTIS HC \$5.50 CSSL

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The author has identified the following significant results. Nine projects are defined, five ERTS data applications experiments and four supporting technology tasks. The most significant applications results were achieved in the soil association mapping, earth surface feature identification, and urban land use mapping efforts. Four soil association boundaries were accurately delineated from ERTS-1 imagery. A data bank has been developed to test surface feature classifications obtained from ERTS-1 data. Preliminary forest cover classifications indicated that the number of acres estimated tended to be greater than actually existed by 25%. Urban land use analysis of ERTS-1 data indicated highly accurate classification could be obtained for many urban categories. The wooded residential category tended to be misclassified as woods or agricultural land. Further statistical analysis revealed that these classes could be separated using sample variance.

N73-29217* Environmental Research and Technology, Inc., Lexington, Mass.

USE OF SATELLITE DATA FOR MAPPING SNOW COVER IN THE WESTERN UNITED STATES

James C. Barnes, Principal Investigator, Clinton J. Bowley, and David A. Simmes 13 Aug. 1973 11 p refs Proposed for presentation at Symp. on Management and Utilization of Remote Sensing Data, Sioux Falls, S. D., 29 Oct. - 2 Nov. 1973 ERTS (Contract NAS5-21803) (E73-10866; NASA-CR-133355) Avail: NTIS HC \$3.00 CSCL 08L

The author has identified the following significant results. The results of the analysis of ERTS imagery for the Arizona and California test sites indicate that the extent of the mountain snowpacks can be mapped from ERTS data in more detail than is depicted in aerial survey snow charts. In addition to comparative analysis with aerial snow charts, the ERTS data have also been compared with high altitude aircraft photography. The results of the comparative analysis indicate that although small details in the snow line that cannot be detected in the ERTS data can be mapped from the higher resolution aircraft data, the boundaries of the areas of significant snow cover can be mapped as accurately from ERTS imagery as from aircraft photography.

N73-29218* Maine State Highway Dept., Bangor.

TO MAP THE DISTRIBUTION OF GLACIOFLUVIAL DEPOSITS AND ASSOCIATED GLACIAL LANDFORMS Bimonthly Progress Report, period ending 1 Jul. 1973

Raymond G. Woodman, Principal Investigator 8 Jul. 1973 2 p ERTS (Contract NAS5-21747) (E73-10867; NASA-CR-133380; BMPR-7) Avail: NTIS HC \$3.00 CSCL 08L

N73-29220* National Environmental Satellite Service, Hillcrest Heights, Md.

EVALUATION OF ERTS DATA FOR CERTAIN HYDROLOGICAL USES Status and Technical Progress Report, Jan. - Jun. 1973

Donald R. Wiesnet, David F. McGinnis, Principal Investigators, and Michael Matson 1 Jul. 1973 28 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (NASA Order S-70246-AG) (E73-10869; NASA-CR-133382) Avail: NTIS HC \$3.50 CSCL 08H

The author has identified the following significant results. Mapping of snow cover using ERTS-1 data proved to be six times faster than that done from U-2 photography. However, NOAA-2 VHRR snow cover mapping was almost as fast as ERTS-1, and it is available more frequently. Ice conditions in the Great Lakes can be readily determined by ERTS-1. Ice features characteristic of thawing conditions such as rotten ice, lack of pressure ridges, brash belts, and compacted ice edges can be identified. A great decrease in apparent reflectivity in band 7 as

compared to band 4 also indicated melting conditions. Using sidalap from two successive ERTS-1 images of Lake Erie (February 17 and 18, 1973) a measure of ice movement was made, agreeing closely with the estimate from conventional methods. The same imagery permitted tentative identification of the following features: shuga, light and dark nilas, fast ice, icefoot, ice breccia, brash ice, fracturing, ridging, rafting, sastrugi, thaw holes, rotten ice, ice islands, dried ice puddles, hummocked ice, and leads.

N73-29237* Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.

A SKYLAB-A PROGRAM FOR THE INTERNATIONAL HYDROLOGICAL DECADE (IHD) Quarterly Report, 8 Mar. - 31 May 1973

Fabian C. Polcyn, Principal Investigator 17 Aug. 1973 2 p EREP (Contract NAS9-13276) (E73-10888; NASA-CR-133526; QR-1) Avail: NTIS HC \$3.00 CSCL 08H

N73-29247* Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.

UTILIZATION OF ERTS-1 DATA TO MONITOR AND CLASSIFY EUTROPHICATION OF INLAND LAKES Interim Report, Feb. - Jul. 1973

Robert H. Rogers and V. Eliot Smith, Principal Investigators (Cranbrook Inst. of Sci., Bloomfield Hills, Mich.) Aug. 1973 118 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (Contract NAS5-21863) (E73-10898; NASA-CR-133555; BSR-4089) Avail: NTIS HC \$8.00 CSCL 08H

The author has identified the following significant results. Significant findings are: (1) one-acre lakes and one-acre islands are detectable; (2) removal of atmospheric parameters derived from RPMI measurements show test lakes to have reflectances of 3.1 to 5.5% in band 4 and 0.3 to 2.3% in band 5; (3) failure to remove reflectance caused by atmosphere results in errors up to 500% in computing lake reflectance from ERTS-1 data; (4) in band 4, up to seven reflectance levels were observed in test lakes; (5) reflectance patterns have been displayed on a color-coded TV monitor and on computer-generated gray scales; (6) deep and shallow water can be separated by a trained photointerpreter and automatic machine processing, with estimates of water depth possible in some cases; (7) RPMI provides direct spectral signature measurements of lakes and lake features such as algal scums and floating plants; (8) a method is reported for obtaining lake color, as estimated by Forel-Ule standards, from ERTS-1 data; (9) a strong correlation between browner water color, diminishing water transparency; and (10) classifying lake eutrophication by observation of surface scums or macrophytes in shallow water seems straightforward.

N73-29262* Alaska Univ., Fairbanks. Inst. of Water Resources.

BREAK-UP CHARACTERISTICS OF CHENA RIVER BASIN Semiannual Technical Report, Feb. - Jul. 1973

Robert F. Carlson, Principal Investigator 31 Jul. 1973 15 p Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (Contract NAS5-21833) (E73-10903; NASA-CR-133560) Avail: NTIS HC \$3.00 CSCL 08L

The author has identified the following significant results. ERTS-1 imagery has been used to monitor the snow melt in central Alaska. Channel 5 was found to give the best results. The VP-8 analyser was utilized to obtain false color images of grey scales and the built-in planimeter with computer was used to obtain quantitative results. It was found that the snow cover increased at high altitudes from mid-February to the beginning of May, while at lower altitudes, there was an increase from

19 Feb. to 27 March, but a decrease to 2 May, as the melting had started. Two aerial stereo flights were used as ground truth measurement of the ERTS-1 imagery. It was found that the snow cover increased with increasing altitude as well as with a northerly exposure, a result to be expected.

N73-29259* Maine State Highway Dept., Bangor.
TO DEVELOP A LAND USE - PEAK RUNOFF CLASSIFICATION SYSTEM FOR HIGHWAY ENGINEERING PURPOSE
 Bimonthly Progress Report, period ending 1 Aug. 1973
 Ernest G. Stoeckeler, Principal Investigator Aug. 1973 2 p
 ERTS
 (Contract NAS5-21772)
 (E73-10910; NASA-CR-133567; BMPR-7) Avail: NTIS HC \$3.00 CSCL 08F

N73-29269* Alaska Univ., Fairbanks. Geophysical Inst.
SURVEY OF THE SEASONAL SNOW COVER IN ALASKA
 Semiannual Technical Report, Feb. - Jul. 1973
 Gunter Weller, Principal Investigator, Carl Benson, and Bjorn Holmgren 31 Jul. 1973 27 p refs ERTS
 (Contract NAS5-21833)
 (E73-10920; NASA-CR-133577; SATR-2) Avail: NTIS HC \$3.50 CSCL 08L

The author has identified the following significant results. The object of this project is to describe freeze-up and breakup patterns of seasonal snow and ice covers in Alaska. During the reporting period, concentration has been on: (1) collection of ground-based data at various places in the north-south transect across Alaska; (2) using the ERTS-1 data together with observations from air and ground to describe the snow cover characteristics on the Arctic Slope during Winter and during the breakup period. Analysis has shown that the ERTS-1 data provides information on break-up pattern including development of runoff over extensive watersheds, areas of low albedo and early snows retreat before the start of the main ablation period, and the extent of large snow drifts and aufeis and aufeis remains after the main ablation period. The ERTS-1 data can also be used to monitor manmade effects on the breakup in the Prudhoe Bay oil exploration area.

N73-29288 Israel Program for Scientific Translations, Ltd., Jerusalem.
SIMULATION OF THE PROBLEM OF RIVER TEMPERATURE DETERMINATION FROM SATELLITES
 A. A. Dmitriev and T. V. Evnevich *In its Actinometry and Atmospheric Optics* (TT-70-50159) 1971 p 60-64 refs
 Transl. into ENGLISH from the book "Aktinometriya i Atmosfer'naya Optika" Izdatel'stvo Valgus, Tallin, 1968 390 p

Narrow-angle radiation detectors mounted on satellites collect radiant energy from territories which are markedly larger than the width of a river. It is therefore important to determine the thermal radiation brightness of the river strip in order to find the river temperature. An experiment, measuring the brightness of a narrow white strip against a homogeneous dark background by means of a scanning radiation detector with a field of view slightly larger than the strip width is described. In these measurements, a smoothed bell-shaped brightness distribution, instead of the true rectangular step distribution was obtained. The peak height was found to be somewhat lower, whereas the width of the spot increased. Author

N73-29324 Israel Program for Scientific Translations, Ltd., Jerusalem.
TEMPERATURE AND RADIATION REGIME OF PADDIES
 S. P. Malevskii *In its Actinometry and Atmospheric Optics* (TT-70-50159) 1971 p 303-307 ref Transl. into ENGLISH from the book "Aktinometriya i Atmosfer'naya Optika" Izdatel'stvo Valgus, Tallin, 1968 390 p

The procedure and the results of temperature measurements and determination of the horizontal variation of meteorological

characteristics in paddies are discussed. The features of the paddies which are caused by the presence of a layer of water are described. The measurement of the temperature of the surface of the paddies using helicopter-borne radiation thermometers was conducted and the results were compared with those obtained by a float thermometer. The absorption of energy over the paddies is expressed as a graph to show the effects of radiation. Author

N73-29382* Scripta Technica, Inc., Washington, D.C.
HYDROGRAPHIC INTERPRETATION OF ORBITAL PHOTOGRAPHS AND POSSIBILITY OF USING THEM IN HYDROLOGIC MAPPING
 T. G. Svatkova NASA Jul. 1973 9 p Transl. into ENGLISH of Inst. of Space Res., Acad. Sci. USSR, Moscow Conf. paper Presented at the Meeting of the Soviet-Am. Working Group on Remote Sensing of the Nat. Environ. from Space, 12-17 Feb. 1973 18 p
 (Contract NASw-2484)
 (NASA-TT-F-14974) Avail: NTIS HC \$3.00 CSCL 08H

Small-scale photographs obtained by satellite crews are superior to topographic maps in accuracy and detail of the hydrographic network they show. Examples of various uses of such photographs for mapping purposes are given. Author

N73-30280* Kansas Univ., Lawrence. Space Technology Center.
SKYLAB STUDY OF WATER QUALITY Progress Report, Mar. - May 1973
 H. L. Yarger, Principal Investigator and James R. McCauley May 1973 8 p EREP
 (Contract NAS9-13271)
 (E73-10938; NASA-CR-133609) Avail: NTIS HC \$3.00 CSCL 08H

N73-30281* Kansas Univ., Lawrence. Space Technology Center.
SKYLAB STUDY OF WATER QUALITY Progress Report, Jun. - Aug. 1973
 H. L. Yarger, Principal Investigator and James R. McCauley Aug. 1973 3 p EREP
 (Contract NAS9-13271)
 (E73-10939; NASA-CR-133610) Avail: NTIS HC \$3.00 CSCL 08H

N73-30298* Geological Survey, Arlington, Va.
DYNAMICS OF SUSPENDED SEDIMENT PLUMES IN LAKE ONTARIO Progress Report, 1 Jan. - 30 Jun. 1973
 Edward J. Pluhowski, Principal Investigator 1 Jul. 1973 13 p refs
 Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
 (NASA Order S-70243-AG-2)
 (E73-10956; NASA-CR-133632) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. Enhancement of ERTS-1 imagery yielded excellent quality 35-mm color slides and prints of several prominent turbidity plumes in Lake Ontario. Selected ERTS-1 frames of the Welland Canal and Genesee River plumes will be used to develop time-lapse sequences showing the impact of wind stress on each plume. Unusually high lake levels during the spring resulted in extensive beach erosion along the entire Lake Ontario shoreline. The resulting high concentrations of suspended matter generated highly turbid (up to 420 JTU) nearshore conditions that appeared milky white in the imagery obtained April 12 and 29th, 1973. During the shipping season, both the Welland Canal and a diversion channel at Port Dalhousie, Ontario, produced readily identifiable turbidity plumes in Lake Ontario. However, in the winter neither plume was visible in the ERTS-1 imagery suggesting sharply lower sediment discharge into Lake Ontario from these sources.

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N73-30313*# Kansas Univ. Center for Research, Inc., Lawrence.

CHANGE IN SURFICIAL WATER AREA, QUIVERA NATIONAL WILDLIFE REFUGE, STAFFORD COUNTY, KANSAS

H. L. Yarger, Principal Investigator 27 Jan. 1973 5 p ERTS (Contract NAS5-21822)
(E73-10974; NASA-CR-133753) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. MSS-7 images acquired in August, October, and December 1972 revealed changes in both the number of water pools and surficial water area of larger pools in Quivera National Wildlife Refuge (Big and Little Salt Marsh), Stafford County, Kansas.

N73-31280 Michigan Univ., Ann Arbor.
MULTISPECTRAL REMOTE SENSING TECHNIQUES APPLIED TO SALINITY AND DRAINAGE PROBLEMS IN THE COLUMBIA BASIN, WASHINGTON Ph.D. Thesis
Virginia Lee Prentice 1972 237 p

Avail: Univ. Microfilms Order No. 73-11232

Data collected and processed for a multispectral remote sensing program to investigate salinity and drainage problems in the irrigated area of the Columbia Basin were subjected to reexamination and indepth comparative analysis in light of the collected ground data and other available information pertaining to relevant facets of the physical environment. Analysis of scanner, thermal model, and field data indicated that original concepts were sound; soil moisture-temperature relationships can be predicted by modeling and are detectable by remote sensing techniques. Experimentation with the model by programming for transpiration and accounting for application of irrigation water should add to the utility of the model. Spectral signatures for several conditions of soil moisture and stages of vegetation stress were substantiated. Dissert. Abstr.

N73-31299*# Corps of Engineers, Waltham, Mass.
NEW ENGLAND RESERVOIR MANAGEMENT Progress Report

Saul Cooper and Duwayne Anderson, Principal Investigators (CRREL) 1 Sep. 1973 4 p EREP
(NASA Order T-4646-B)
(E73-10993; NASA-CR-133772) Avail: NTIS HC \$3.00 CSCL 08H

N73-31309*# Nevada Univ., Reno. Mackay School of Mines.
THE GREAT BASIN INVESTIGATION Monthly Progress Report, Aug. 1973

Jack G. Quade, Principal Investigator 10 Sep. 1973 2 p EREP
(Contract NAS9-13274)
(E73-11004; NASA-CR-133787) Avail: NTIS HC \$3.00 CSCL 05B

N73-31310*# Kansas Univ. Center for Research, Inc., Lawrence.

INTERPRETATION OF LAND USE AND STREAM ORDER, PAWNEE RIVER BASIN, KANSAS

S. A. Morain, Principal Investigator and Donald L. Williams 14 Sep. 1973 6 p ref ERTS
(Contract NAS5-21822)
(E73-11005; NASA-CR-133798) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. Land use and stream orders were mapped from ERTS-1 imagery covering the Pawnee River Basin. Total area of the basin, irrigated dry land crop area, and rangeland area were determined. The stream order of the basin was calculated by the Strahler method and provided more detail than is available on the comparable 1:250,000 sheets. This study has demonstrated the feasibility of using ERTS-1 imagery to map stream networks in greater

detail than is required for 1:250,000 scale. The utility of ERTS-1 has also been demonstrated for mapping and mensuration of data relating to performance of ground cover types and the extent of irrigation.

N73-31316*# Calspan Corp., Buffalo, N.Y.
S190 INTERPRETATION TECHNIQUES DEVELOPMENT AND APPLICATION TO NEW YORK STATE WATER RESOURCES Quarterly Report, 1 Jun. - 31 Aug. 1973
Kenneth R. Piech, Principal Investigator 31 Aug. 1973 5 p refs EREP
(Contract NAS9-13336)
(E73-11011; NASA-CR-133804; OR-2) Avail: NTIS HC \$3.00 CSCL 05B

N73-31332*# Geological Survey, Miami, Fla.
MAPPING DYNAMIC HYDROLOGIC CONDITIONS OF SURFACE WATER CHANGES IN SOUTH FLORIDA USING REPETITIVE ERTS-1 DATA INTERFACED WITH DCP'S Progress Report, 1 Jun. - 31 Jul. 1973
Aaron L. Higer, Principal Investigator, A. E. Coker, E. H. Cordes, and E. T. Wimberly Jul. 1973 9 p ERTS
(NASA Order S-70243-AG-7)
(E73-11028; NASA-CR-133825) Avail: NTIS HC \$3.00 CSCL 08H

N73-31340*# Environmental Research and Technology, Inc., Lexington, Mass.

STUDY TO DEVELOP IMPROVED SPACECRAFT SNOW SURVEY METHODS USING SKYLAB/EREPA DATA

Quarterly Progress Report, 14 Jun. - 15 Sep. 1973
James C. Barnes, Principal Investigator 15 Sep. 1973 5 p EREP
(Contract NAS9-13305)
(E73-11036; NASA-CR-133882; ERT-P-412-4-QPR-2) Avail: NTIS HC \$3.00 CSCL 08L

The author has identified the following significant results. The initial analysis of EREP data from the SL-2 mission has been undertaken. Snow distributions are being mapped from the S190A photography for three mountain areas: the Sierra Nevadas; the Cascades near Washington-Oregon border; and the Wasatch Range in Utah. In the S192 screening film, a dramatic reversal in the reflectance of the snow in the Wasatch Range is observed between the visible and near IR channels. In channel 2 (0.48 - 0.61 microns) the snow has a high reflectance, whereas in channel 11 (1.55 - 1.75 microns) the snow appears almost black, having a much lower reflectance than the surrounding terrain. The sharp drop in reflectance in the near IR channel is believed to be due to the existence of melt water on the snow surface. Although investigators have reported this effect previously using ERTS-1 imagery, the S192 data provides the first opportunity to study quantitatively the snow reflectance in several visible and near IR channels. The results will have direct application for developing a technique to determine the condition of the snow surface (i.e., dry of melting), a significant parameter in snow hydrology.

N73-31342*# Army Coastal Engineering Research Center, Washington, D.C.

ESTUARY AND BARRIER ISLAND STUDY

Progress Report, Jul. - Aug. 1973
Dennis W. Berg, Principal Investigator Aug. 1973 2 p ERTS
(NASA Order S-70260-AG)
(E73-11041; NASA-CR-133922) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. Scan line distortion is apparent in ERTS-1 imagery, imparting a serrated-edge appearance to shorelines. This feature however does not hinder observation and interpretation of broad features such as shoaling areas and sediment plumes. Shoaling in the backshore areas and inlets is easily discernible in spectral bands 4 and 5. Contrast between land and water is especially striking in spectral band 7, allowing easy identification of tidal flat areas.

N73-31360* Grumman Aerospace Corp., Bethpage, N.Y.
PHOTOMETRIC AND POLARIMETRIC MAPPING OF WATER TURBIDITY AND WATER DEPTH Final Report
 John Halajian and Herbert Hallock Aug. 1973 148 p refs
 (Contract NAS9-12963)

(NASA-CR-134030) Avail: NTIS HC \$9.50 CSCL 08J

A Digital Photometric Mapper (DPM) was used in the Fall of 1971 in an airborne survey of New York and Boston area waters to acquire photometric, spectral and polarimetric data. The object of this study is to analyze these data with quantitative computer processing techniques to assess the potential of the DPM in the measurement and regional mapping of water turbidity and depth. These techniques have been developed and an operational potential has been demonstrated. More emphasis is placed at this time on the methodology of data acquisition, analysis and display than on the quantity of data. The results illustrate the type, quantity and format of information that could be generated operationally with the DPM-type sensor characterized by high photometric stability and fast, accurate digital output. The prototype, single-channel DPM is suggested as a unique research tool for a number of new applications. For the operational mapping of water turbidity and depth, the merits of a multichannel DPM coupled with a laser system are stressed. Author

N73-31903* National Aeronautics and Space Administration.
 Goddard Space Flight Center, Greenbelt, Md.

PASSIVE MICROWAVE IMAGES OF LAKE ICE c14
 Per Gloersen *In its Significant Accomplishments in Sci.* 1973
 p 187-189
 CSCL 14E

Photographic data and microwave emission images from the Great Lake ice formation are compared for their applicability to commercial shipping interests. A synoptic view of the microwave radiation from the lake area ice shows a large variation in brightness temperature. The snow ice appears to have the highest microwave brightness temperatures, whereas the thick clear ice shows up some 30 degrees kelvin colder, and the thin clear ice is colder still with a 1.55 cm radiation. G.G.

N73-32217* Environmental Research and Technology, Inc.,
 Lexington, Mass.

EVALUATE THE APPLICATION OF ERTS-A DATA FOR DETECTING AND MAPPING SNOW COVER Bimonthly
 Progress Report, 10 Jul. - 10 Sep. 1973

James C. Barnes, Principal Investigator 27 Sep. 1973 5 p
 ERTS

(Contract NAS5-21803)

(E73-11038; NASA-CR-133884; ERT-P-407-7; BMPR-5) Avail:
 NTIS HC \$3.00 CSCL 08L

The author has identified the following significant results. It is concluded from data analysis that the amount of information in ERTS-1 imagery with practical application to snow mapping is substantial. For the Arizona and California test sites, it appears that the extent of the mountain snowpacks can be mapped from ERTS-1 data in more detail than is depicted in aerial survey snow charts. In the Salt-Verde watershed, the agreement between the percentage of the area snow covered as measured from the ERTS-1 data and from aerial survey charts is generally well within 10%. In nearly all of the areas in which greater discrepancies occur, the differences can be explained by changes in snow cover during the interval between the two observations. In the southern Sierra Nevada, the agreement between ERTS-1 data and aerial survey charts is of the order of 5% in all cases, except for the Kaweah Basin on one date. In addition to comparative analysis with aerial snow charts, the ERTS-1 data have also been compared with high altitude aircraft photography. The ERAP data have provided an excellent source of correlative information. The results of the comparative analysis indicate that although small details in the snow line that cannot be detected in the ERTS-1 data can be mapped from higher resolution aircraft data, the boundaries of snow cover can be mapped just as accurately from ERTS-1 data.

N73-32230* Stanford Research Inst., Menlo Park, Calif.
 Atmospheric Sciences Lab.

STUDY OF TIME LAPSE PROCESSING FOR DYNAMIC

HYDROLOGIC CONDITIONS Progress Report, 6 Mar.
 6 Sep. 1973

Sidney M. Serebreny, Principal Investigator 6 Sep. 1973 30 p
 Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue,
 Sioux Falls, S. D. 57198 ERTS
 (Contract NAS5-21841)

(E73-11054; NASA-CR-133935) Avail: NTIS HC \$3.50 CSCL
 08H

N73-32245* American Univ., Washington, D.C.

ERTS-A DATA USER INVESTIGATION OF ERTS INFORMATION SYSTEM DEVELOPMENT FOR POTOMAC RIVER BASIN NATURAL RESOURCE MANAGEMENT Progress
 Report, Nov. 1972 - Jun. 1973

N. H. MacLeod, Principal Investigator Jun. 1973 55 p refs
 ERTS

(Contract NAS5-21892)

(E73-11069; NASA-CR-135525; PR-1) Avail: NTIS HC
 \$4.75 CSCL 08H

N73-32257* Purdue Univ., Lafayette, Ind. Lab. for Application
 of Remote Sensing.

A STUDY OF THE UTILIZATION OF ERTS-1 DATA FROM THE WABASH RIVER BASIN Bimonthly Progress Report,
 1 Jul. - 31 Aug. 1973

David A. Landgrebe, Principal Investigator 31 Aug. 1973 5 p
 ERTS

(Contract NAS5-21773)

(E73-11082; NASA-CR-135539) Avail: NTIS HC \$3.00 CSCL
 08H

The author has identified the following significant results. The crop identification effort produced results indicating difficulty in discriminating cotton and soybeans in the Missouri area in the late August, September-October period. The use of prior probabilities in classification was shown to increase performance significantly. The use of temporal data was observed to improve classification accuracy for September 14 and October 2 data but not for August 26 data. Geometric correction and temporal overlay processing of ERTS-1 data proved to be very valuable for field location and relationship of fields from one time to another. Precision geometric correction of ERTS-1 data was achieved using manually derived ground control checkpoints.

N73-32261* Mississippi State Univ., State College. Inst. for
 Environmental Studies.

APPLICATION OF ERTS-A DATA TO AGRICULTURAL PRACTICES IN THE MISSISSIPPI DELTA REGION Interim
 Report, Apr. - Oct. 1973

C. W. Bouchillon, Principal Investigator, F. M. Ingels, and R. W.
 Boyd Oct. 1973 9 p ERTS

(Contract NAS5-21881)

(E73-11094; NASA-CR-135562) Avail: NTIS HC \$3.00 CSCL
 02C

N73-32267* Minnesota Univ., Minneapolis. Dept. of Physics.
REMOTE SENSING IN LAKE SUPERIOR STUDIES

Michael Sydor *In its A study of Minn. Forests and Lakes using
 Data from ERTS* 30 Jun. 1973 p 1-70 refs

CSCL 08H

An investigation was made of surface water transport in the extreme western arm of Lake Superior from July 25 to September 15, 1972. Temperature and water velocity profile measurements were made to determine the nature of currents at the tip of the lake. Bathythermographs and thermistor probes were used for these measurements. From the end of July to August 9, no pronounced steady stratification took place. A series of days with variable winds produced, under N.E. winds, warm water pileup at the tip of the lake, which was subsequently driven out by westerly winds. Some evidence of upwelling was indicated by cold surface waters near the shore. After August 9 considerable stratification with slight upwelling was noted.

E.H.W.

N73-32270* Minnesota Univ., Minneapolis.

USE OF REMOTE SENSING IN THE ANALYSIS OF

06 HYDROLOGY AND WATER MANAGEMENT

SNOWMELT FLOODS

C. Edward Bowers *In its* A Study of Minn. Forests and Lakes using Data from ERTS 30 Jun. 1973 p 78-85

CSCL 08L

An evaluation was made of remote sensing data, particularly ERTS imagery, in an effort to establish its suitability as an aid in determining percent of snow cover and water content of snow on the ground. Resulting data are used with mathematical simulation models to forecast spring snowmelt floods. Author

N73-32298# Istituto di Fisica Dell Atmosfera, Rome (Italy). THERMAL SURVEYS ON GARDA LAKE USING INFRARED EQUIPMENT

M. Giorgi, M. Colacino, and F. M. Vivona Jan. 1973 54 p refs In ITALIAN; ENGLISH summary (IFA-STR-23) Avail: NTIS HC \$4.75

Annual variations of the Garda Lake surface temperature were studied by bolometric measurements using helicopter-borne devices. Superficial isotherms were derived for two sets of flights performed in different months. Thermal anomalies of morning-evening inversions were analyzed. Earth based thermograms, obtained by using the thermovision instrument are presented and compared to bolometer measurements. ESRO

N73-33248*# Alaska Univ., Fairbanks. Inst. of Water Resources. BREAK-UP CHARACTERISTICS OF CHENA RIVER BASIN Bimonthly Progress Report

Robert F. Carlson, Principal Investigator 31 Sep. 1973 5 p ERTS (Contract NAS5-21833) (E73-11085; NASA-CR-135553; BMPR-7) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. Results from snowmelt model were obtained showing the decreasing changes in snow depth for four elevational ranges in the Chena River Basin. This model is based on the energy balance of the snowpack and the results are shown on attached figures. Also, the measured hydrographs for two stations on the Chena River are shown. The next phase of the study will be to analyze the model using both ERTS-1 imagery and measured field values.

N73-33249*# Alaska Univ., Fairbanks. SURVEY OF THE SEASONAL SNOW COVER IN ALASKA Bimonthly Progress Report

Gunter E. Weller, Principal Investigator 10 Oct. 1973 1 p ERTS (Contract NAS5-21833) (E73-11086; NASA-CR-135554; BMPR-7) Avail: NTIS HC \$3.00 CSCL 08L

N73-33259*# Texas Technological Univ., Lubbock. Remote Sensing Lab. DYNAMICS OF PLAYA LAKES IN THE TEXAS HIGH PLAINS Progress Report, Apr. - Sep. 1973

C. C. Reeves, Jr., Principal Investigator 30 Sep. 1973 10 p ERTS (Contract NAS5-21720) (E73-11102; NASA-CR-135571) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. This project is designed to correlate ERTS-1 satellite imagery signatures with the water balance ecosystem and geology of select playa lake basins in West Texas. The principal work consisted of monitoring the weather instruments, the measurement of water levels and water depths examination of MSS imagery, and measurement of water and mud areas by use of ESIAC (Electronic Satellite Image Analysis Console) at Stanford Research Center, Menlo Park, California. A cost/benefit analysis, comparing the use of ERTS-1 data to more conventionally secured data, revealed that use of ERTS-1 data for such a survey reduces cost from \$2.00 to \$0.03/square mile.

N73-33268*# Pennsylvania State Univ., University Park. Space Science and Engineering Lab. INVESTIGATION OF VEGETATIVE COVER CONDITIONS Interim Report

George J. McMurtry, Gary W. Petersen, Principal Investigators, B. F. Merembeck, and F. Y. Borden May 1973 15 p ref ERTS (Contract NAS5-23133) (E73-11111; NASA-CR-135580; ORSER-SSEL-TR-21-73) Avail: NTIS HC \$3.00 CSCL 08F

N73-33278*# Nevada Univ., Reno. Mackay School of Mines. THE GREAT BASIN INVESTIGATION Monthly Progress Report, Sep. 1973

Jack G. Quade, Principal Investigator Sep. 1973 2 p EREP (Contract NAS9-13274) (E73-11123; NASA-CR-135661) Avail: NTIS HC \$3.00 CSCL 08F

N73-33284*# Environmental Research Inst. of Michigan, Ann Arbor. FRESH-WATER ICE INTERPRETATION FROM ERTS IMAGERY Bimonthly Report, 1 Jul. - 31 Aug. 1973

M. Leonard Bryan, Principal Investigator 19 Sep. 1973 27 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (Contract NAS5-21783) (E73-11129; NASA-CR-135676; ERIM-193300-30-X; BMR-6) Avail: NTIS HC \$3.50 CSCL 08L

N73-33313*# State Power Board, Oslo (Norway). SNOW SURVEYING TO ASSESS RISK OF SPRING FLOOD AND SNOW STORAGE IN AREAS OF HYDRO-POWER STATIONS

Helge Odegaard, Principal Investigator 27 Sep. 1973 1 p Sponsored by NASA ERTS (E73-11160; NASA-CR-135749) Avail: NTIS HC \$3.00 CSCL 08H

N73-33314*# Geological Survey, Washington, D.C. UTILIZATION OF REMOTELY-SENSED DATA IN THE MANAGEMENT OF INLAND WETLANDS

Virginia Carter and Doyle G. Smith [1973] 15 p refs Prepared in cooperation with American Univ., Washington, D. C. Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (Contract NAS5-21752; NASA Order S-70243-AG) (E73-11161; NASA-CR-135755) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. ERTS-1 data and aerial photography are proving to be a useful tool for the inventory and management of inland wetlands. Two examples of the application of remotely-sensed data to specific wetland management needs or requirements are discussed. Studies of the Great Dismal Swamp are utilizing ERTS-1 imagery and color IR photography in: (1) study area selection; (2) field inspection; (3) vegetation mapping; (4) identification of drainage characteristics and moisture regime; (5) location of intensive study areas; and (6) detection of change. Thematic extractions of ERTS-1 data made using the United States Geological Survey's Autographic Theme Extraction System are aiding analyses of swamp hydrologic regime and providing information pertinent to quick recognition and inventory of wetlands from ERTS-1. DCP's in south Florida wetlands provide near-real time data for water resources managers. Data relayed by satellite can be entered into models to provide predictive data and water storage information for long-term and short-term decision making.

N73-33318*# Pennsylvania State Univ., University Park. Office for Remote Sensing of Earth Resources (ORSER).

INTERDISCIPLINARY APPLICATIONS AND INTERPRETATIONS OF ERTS DATA WITHIN THE SUSQUEHANNA RIVER BASIN Progress Report, Feb. - Mar. 1973

G. J. McMurtry and G. W. Petersen, Principal Investigators

31 Mar. 1973 14 p refs ERTS

(Contract NAS5-23133)

(E73-11165; NASA-CR-135759; ORSER-SSEL-TR-8-73) Avail:

NTIS HC \$3.00 CSCL 08H

07

DATA PROCESSING AND DISTRIBUTION SYSTEMS

Includes film processing, computer technology, satellite and aircraft hardware, and imagery.

A70-16686

THE DESIGN OF A RESOURCES SURVEY SYSTEM.

Michael Richter (TRW Systems Group, Redondo Beach, Calif.). (Institute of Electrical and Electronics Engineers, Annual International Geoscience Electronics Symposium, 1st, Washington, D.C., Apr. 16-18, 1969.) *IEEE Transactions on Geoscience Electronics*, vol. GE-7, Oct. 1969, p. 200-205.

Description of the resources survey system (RSS) which produces optical-spectrum imagery of the continental United States with both photometric and photogrammetric fidelity. The data volume is determined, and the ground processing requirements are developed into a conceptual system fully loading a second-generation computer. To achieve a manageable ground system, the use of a line scanner is required; the characteristics of the sensor dictate a small spacecraft adapted to Scout or piggyback launch. Extension of the system to make possible automatic signature recognition and incorporation of aircraft and groundtruth is straightforward. RSS is therefore a prototype in the sense that its limited performance can evolve without basic redesign into any foreseeable system, and operational in that its output is immediately and routinely usable both in its form and in its content. Z.W.

A70-17887

NIGHTTIME LATITUDINAL TEMPERATURE DISTRIBUTION OF THE F2 REGION OF THE IONOSPHERE IN QUIET AND DISTURBED CONDITIONS AS CALCULATED FROM DATA OF THE SATELLITE ALOUETTE 1.

M. N. Fatkullin. (*Kosmicheskie Issledovaniia*, vol. 7, May-June 1969, p. 425-428.) *Cosmic Research*, vol. 7, May-June 1969, p. 382-385. 15 refs. Translation.

Determination of the latitude distribution of effective temperature in the ionosphere and the temperature gradient with respect to the magnetic activity (in the time of 22 to 03 hours LT) in the equinoctial periods. It is shown that (1) under calm and disturbed geomagnetic conditions the temperature rises with increasing latitude, and (2) with the exception of latitudes from 0 to 35 S, the temperature increases with increasing magnetic activity. P.G.

A70-19196

DATA UTILIZATION FROM METEOROLOGICAL SATELLITES.

Clifford A. Spohn (ESSA, National Environmental Satellite Center, Suitland, Md.). *New York Academy of Sciences, Transactions, Series 2*, vol. 31, Dec. 1969, p. 1103-1105.

Discussion of the uses being made of the data provided by the operational environmental satellite system after the first three years of operation. The data are presented to the analyst in two forms: analog-produced single pictures and computer-produced digital mosaics. At the Center a number of analyses are produced. Some are from each orbital coverage as received; others are at set daily times to provide information on a standard schedule for the use of the National Meteorological Center. The first is the locating of actual or incipient tropical storms. A second major program is the analysis of synoptic weather patterns. G.R.

A70-19778

METHODOLOGY OF AIR-PHOTO-INTERPRETATION AS ILLUSTRATED FROM THE SOIL SCIENCES.

(Universität Karlsruhe and Firma Carl Zeiss, Photogrammetrische Wochen, 32nd, Karlsruhe, West Germany, Sept. 29-Oct. 10, 1969.) *Bildmessung und Luftbildwesen*, vol. 38, Jan. 1, 1970, p. 35-44. 26 refs.

Discussion of the methodology of air-photo-interpretation on the basis of examples from the soil sciences taking into consideration the concept of the 'reference level' of the photointerpreter. General aspects of the interpretation of aerial photographs are examined. Engineering soil science and pedology are considered. It is pointed out that the methodology of photointerpretation also encompasses the various steps of photoproduction, the image formation and the psychology of the photointerpretation. G.R.

A70-22259

Television from space. Peter Wood (RCA, Astro-Electronics Div., Princeton, N.J.). (*American Society of Photogrammetry, Annual Meeting, 35th, Washington, D.C., Mar. 9-14, 1969.*) *Photogrammetric Engineering*, vol. 36, Feb. 1970, p. 141-150. 13 refs.

The Earth Resources Satellite will include three high-resolution television cameras, each operating on a different spectral band. In many applications, such as land-use surveys, the data will be correlated with topographic maps. However, television systems are subject to photogrammetric errors, and pre-processing of the data is necessary if the desired photogrammetric quality is to be achieved. The high-resolution system of the Earth Resources Mission must be processed in real time including corrections for photogrammetric errors such as scale, skew, roll, yaw, pitch, earth rotation, etc.

(Author)

A70-22852 #

Precision processing for earth resource satellite imagery. W. F. Storer and D. S. Webber (TRW Systems Group, Redondo Beach, Calif.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-297*. 7 p. Members, \$1.00; nonmembers, \$1.50.

Description of optical techniques of high processing accuracy for earth resource satellite imagery. The impact of the system performance function and use requirements upon the choice of methods for image processing is considered. The areas of precision image processing given special attention are: (1) sensor and transmission link distortions, (2) requirements on image quality for geometric accuracy, radiometric fidelity, and freedom from noise, and (3) the choice of image processing approach, optical or digital. When digital processing is necessary, the characteristics of the required algorithms operating at high speed are delineated. M.V.E.

A70-22854 #

Data management system design. Jack Wing (TRW Systems Group, Redondo Beach, Calif.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-321*. 10 p. 8 refs. Members, \$1.00; nonmembers, \$1.50.

To fully obtain the potential economic benefits of an earth resources program will require an efficient data management system. This paper considers in broad terms a data management system for processing data obtained from vidicon cameras and multispectral line scanners with a satellite as the platform for the sensor. The data management system consists of three major components—Mission Control Center, Data Processing Center, and Data Distribution Center. The Mission Control Center performs the functions of spacecraft monitoring, mission planning, and command generation. The Data Processing Center processes all video data received from the data acquisition sites taking into consideration the various radiometric and geometric errors. The Data Distribution Center is the production facility and information management center for the ground system. It generates and forwards the output products to the users and maintains a data file from which data can be efficiently extracted and updated. (Author)

07 DATA PROCESSING AND DISTRIBUTION SYSTEMS

A70-22856 # Some experimental results in earth resources data transmission—BOMEX 1969. S. D. Dorfman, J. R. Castaldo, and W. L. Exner (Hughes Aircraft Co., El Segundo, Calif.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970; Communications Satellite Systems Conference, 3rd, Los Angeles, Calif., Apr. 6-8, 1970, Paper 70-328.* 11 p. Members, \$1.00; nonmembers, \$1.50.

The forthcoming NASA Earth Resources Technology Satellite (ERTS) program will raise new technical challenges for receiving and reproducing multispectral imaging data from satellites. Data rates in the order of 15 megabits/sec must be received and converted into hard copy photographs. The techniques for reception and reproduction of satellite imagery have been pioneered in the meteorological and Application Technology Satellite (ATS) programs. One example is the Hughes Aircraft Company ground terminal which is capable of receiving and reproducing images from the ATS-1 and -3 spin scan cameras. This terminal was recently used as part of the Barbados Oceanographic and Meteorological Experiment (BOMEX) on the island of Barbados during July 1969. This paper describes the Hughes terminal and the results of the picture reception with this terminal prior to and during the BOMEX test. It also describes how these results can be extrapolated to earth resources imagery from scanning radiometers associated with the ERTS. (Author)

A70-22857 # Earth resources data collection by communication satellite—Problem, scope, and some potential solutions. G. M. Northrop (Travelers Research Corp., Hartford, Conn.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970; Communications Satellite Systems Conference, 3rd, Los Angeles, Calif., Apr. 6-8, 1970, Paper 70-327.* 13 p. Members, \$1.00; nonmembers, \$1.50.

Outline of some facets of the expected diverse collection requirements for earth resources data and some potential solutions for meeting these requirements within the scope of the communication satellite technology of the early 1970's. It is pointed out that in the decade of the seventies it may be anticipated that efforts will be made to collect synoptically earth resources data from thousands to tens of thousands of in situ data collection platforms. Collection by satellite appears to afford economies of scale, as well as ample growth potential. Total required rf bandwidth appears to be modest, and operation in the VHF portion of the spectrum looks feasible. Of the required rf bandwidth, perhaps 50% may be required to locate mobile data collection platforms, such as horizontal sounding balloons and free-drifting data buoys. M.M.

A70-22858 # Problems and suggested solutions for earth resources satellites data communications systems. M. Noda (Hughes Aircraft Co., Data Systems Div., Culver City, Calif.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970; Communications Satellite Systems Conference, 3rd, Los Angeles, Calif., Apr. 6-8, 1970, Paper 70-325.* 13 p. 20 refs. Members, \$1.00; nonmembers, \$1.50.

Discussion of some major problems faced by communication system designers in developing data communication systems of the earth resource technology satellites, and some feasible solutions. Basically all these problems are part of one major problem; the rapid and reliable transfer of a very large amount of data within limited bandwidth and in a limited tracking time. The possible solutions to these problems include time-division multiplexing, digitizing, coding, and the use of higher frequencies than 10 GHz to avoid frequency sharing problems. The lack of continuous contact between the satellites and the ground stations may be remedied by deploying data relay satellites in geostationary orbits. O.H.

A70-22863 # Earth Resources National Data Processing Center—Why, what, when, how much? E. Hart and N. Gutlove (Fairchild Camera and Instrument Corp., Syosset, N.Y.). *American*

Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-324. 8 p. Members, \$1.00; nonmembers, \$1.50.

At present, the Earth Resources program is a relatively small R&D activity primarily concerned with sensor evaluation and the development of data manipulation and analysis techniques. The latter are conducted by Principal Investigators at universities and industrial laboratories throughout the country. However, as techniques become perfected a central data processing facility should adopt them, and assume responsibility for their operational use. The Center is viewed as a vital element in what eventually will be a world-wide Earth Resources data network. A full-scale facility should be achievable by 1980 and will approach the size of current large NASA field centers. Because of the magnitude and evolutionary nature of the program, the only practical course is to plan and develop an interim facility first, then use that experience to refine the approach toward end goals. Estimates of facility functions, sizing and costs are presented. (Author)

A70-22864 # Requirements and techniques for an earth resources automatic data correlation system. R. Wakeman and E. Hart (Fairchild Camera and Instrument Corp., Syosset, N.Y.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-323.* 10 p. Members, \$1.00; nonmembers, \$1.50.

A fundamental assumption of the Earth Resources program is that spectrally-selective emission and reflection will uniquely identify all objects of interest on the earth's surface. A large and growing effort to implement this concept is currently underway. However, even when all signatures of interest have been derived and identified, there remains the formidable problem of designing a working production system. One of the major facets of this design problem is that of correlating the information taken from different sensors, at different vantage points and at different times, over non-flat terrain, and reducing these data to the signatures existing at specific ground locations. Furthermore, both aircraft and spacecraft collections must be accommodated. The approach described employs ground-coherent grid line overlays rather than geometrically corrected imagery; the construction is performed by a unique correlation method using orthophotomaps. Four advantages are thereby gained: lower cost, faster processing, degraded imagery, and compensation for vehicle perturbations and terrain relief. (Author)

A70-22865 # Analysis of large-scale aerospace data acquisition, processing, handling and dissemination systems. Stephen Harrison, William E. Brockman, and William P. Sommers (Booz, Allen Applied Research, Inc., Bethesda, Md.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-322.* 14 p. Members, \$1.00; nonmembers, \$1.50.

Discussion of general principles of sound system design for large-scale data systems and information networks dedicated to weather forecasting, scientific data collection, analysis and dissemination, military command and control functions, natural resources information gathering, and many others. Five examples which have been investigated in depth are considered: (1) Weather Bureau data acquisition network; (2) environmental data processing, National Weather Records Center; (3) information processing from scientific satellites, Goddard Space Flight Center; (4) National Space Science Data Center; and (5) proposed satellite system for surveying crops and forestry. Conclusions are reached in the form of guidelines for the design of systems of the complexity of an earth resources data system. M.M.

A70-22866 # Data management at the National Space Science Data Center. J. I. Vette and N. Karlow (NASA, Goddard

Space Flight Center, National Space Sciences Data Center, Greenbelt, Md.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-320*. 12 p. 6 refs. Members, \$1.00; nonmembers, \$1.50.

Discussion of the data management problems of the National Space Science Data Center (NSSDC). Though providing the means for the dissemination and analysis of space science data beyond that provided by the original experimenter constitutes its primary function, and NSSDC is therefore not an operational data processing center proper, it nevertheless has to perform rather great data management tasks. These tasks are considerably magnified by NSSDC's secondary functions arising from space science data needs of various user groups other than the principal planners or investigators in the fields concerned. The experiences of NSSDC in these secondary uses of space science data are discussed. With a present annual generation rate of space science information bits of the order of 10 to the 12th power, the data management problems become significant, and considerable data processing is required before maximum utilization of the data base can be realized. In addition, NSSDC must be concerned with an information system to handle documentation, performance data, instrument calibration and characteristics, and management information. M.V.E.

A70-22885 * # Data handling, data analysis and ground verification of color and multi-spectral imagery for coastal surveying. Alfred C. Conrod, Edwin A. Olsson (MIT, Cambridge, Mass.), and Michael M. Miller (NASA, Electronics Research Center, Cambridge, Mass.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-299*. 12 p. 12 refs. Members, \$1.00; nonmembers, \$1.50. Contract No. NAS 12-2213.

Investigations of instrumentation and techniques for remote sensing on a populated coastal area are described. Survey data taken by aerial photography, multispectral scanners and infrared scanners were evaluated according to the actual and projected information system requirements of user groups involved in monitoring the coastal environment in operational and enforcement roles. The experiment was directed toward determining the environmental effects of intensive human activity. Models were prepared for coastal processes, as seen by visible and infrared remote sensors, to relate time-spaced data to real events. The models were designed for EDP, allowing for masses of data, and implications for operational survey and information systems were considered for use in evaluating alternative approaches. In this case, the accuracy of the conclusions drawn from remote sensor data analyses were verified with data gathered by ground parties, operating in conjunction with the aircraft, using standard field survey techniques. (Author)

A70-22886 # Multi-discipline applications for Earth Resources Satellite data. C. R. Smith and P. Wood (RCA, Astro Electronics Div., Princeton, N.J.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-298*. 9 p. Members, \$1.00; nonmembers, \$1.50.

Study conducted to determine multi-discipline applications for Earth Resources Satellite data for two specific users organizations. It has been possible to extract the types of information associated with primary applications determined for each user. It is concluded that imaging data generated by an Earth Resources Satellite can be of immediate value to already established, efficient organizations in their daily activities, to supplement their existing sources of data and to provide them with information not currently available. G.R.

A70-22891 # Data analysis and remotely sensed data. David A. Landgrebe (Purdue University, Lafayette, Ind.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md.,*

Mar. 2-4, 1970, Paper 70-292. 13 p. 5 refs. Members, \$1.00; nonmembers, \$1.50.

A tutorial discussion about data analysis for Earth Resources is given with emphasis on machine analysis as compared with (manual) photointerpretation. The discussion begins with an overview of an Earth Resources information system. The need is stressed for insuring compatibility between the sensor and the analysis procedure. The underdeveloped state of the data consumption portion of the system is pointed out. The role that ground truth information can play in an operational system is indicated. Sensor systems are discussed from the analyst's viewpoint. Tradeoffs between manual and machine analysis of data are discussed together with a categorization of types of sensors. Pattern recognition techniques for data analysis are briefly reviewed. Example results using primarily spatial information and others using primarily spectral information are given. The value of temporal information in earth resources problems is also indicated as are data handling difficulties it presents. (Author)

A70-22894 # Earth resources data processing as viewed from an environmental satellite data processing experience base. C. L. Bristol (ESSA, National Environmental Satellite Center, Suitland, Md.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-284*. 10 p. 7 refs. Members, \$1.00; nonmembers, \$1.50.

Parallelisms are drawn between the projected information extraction efforts using imaging sensors on earth resources satellites and the similar efforts currently in progress with environmental satellite imaging sensors. Global mapping of digitized vidicon imagery from the TIROS Operational Satellite (TOS) system over the past several years and an extended experimental mapping operation using spin scan imagery from Applications Technology Satellites (ATS) has provided the experience base. Display inadequacies are discussed for the case of manual information extraction with input data from large dynamic range imaging scanners. In-flight vidicon response variations are presented, and the need for response normalization and close signal monitoring is stressed. The photogrammetric experiences with vidicons and scanners—the problems in X,Y raster normalization and satellite attitude determination—are related to the earth resources mission with particular reference to multi-channel coincidence requirements for 'signature' extraction. (Author)

A70-24371 * Collection and relay of earth resources data. S. D. Dorfman (Hughes Aircraft Co., Space Systems Div., El Segundo, Calif.). In: *International Telecommunications Satellite Consortium and Institution of Electrical Engineers, International Conference on Digital Satellite Communication, London, England, November 25-27, 1969, Proceedings*. London, Institution of Electrical Engineers, 1969, p. 543-558. 5 refs. Contract No. NSR-09-012-909.

Investigation of the applicability of a satellite system for collection of earth resources data from in situ sensors. A projection of in situ platforms for the mid-1970's is made. A number of data collection platforms and their message sizes are estimated, extrapolating from the existing system and projecting from present plans. The wide variety of types, locations, message lengths, and reporting intervals are defined. It is found that relatively small messages have to be collected from a large number of platforms. Four general types of data collection are identified: synoptic, local time, emergency, and demand. G.R.

A70-24502 Equidensity film as an aid in photo interpretation (Der Äquidensitenfilm als Hilfsmittel bei der Photointerpretation). E. Ranz and S. Schneider. *Bildmessung und Luftbildwesen*, vol. 38, Mar. 1, 1970, p. 123-134. 8 refs. In German.

Description of the characteristics and potentialities of a new equidensity film. In marked contrast to the fairly complex and

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laborious equidensity methods heretofore available, the new film makes possible a direct, simple, and quick production of equidensities. Some of the practical possibilities of the new equidensity film are illustrated by examples of applications to remote sensing in hydrology and land use. M.V.E.

A70-25636 * # Color enhancement of Nimbus high resolution infrared radiometer data. E. R. Kreins (USAF, Environmental Technical Applications Center, Washington, D.C.) and L. J. Allison (NASA, Goddard Space Flight Center, Greenbelt, Md.). *Applied Optics*, vol. 9, Mar. 1970, p. 681-686. 9 refs.

Two examples of Nimbus high resolution infrared radiometer (HRIR) data processed by a color display enhancement system demonstrate possible meteorological, oceanographic, and geomorphological applications of this technique for geophysical research. A commonly used means of displaying radiation temperatures mapped by the HRIR has been a black and white photofacsimile film strip. However, the human eye can distinguish many more colors than shades of gray, and this characteristic permits an analyst to evaluate quantitatively radiation values mapped in color more readily than in black and white. (Author)

A70-26943 # Data handling for earth resources satellite data. H. M. Gurk, C. R. Smith, and P. Wood (RCA, Princeton, N.J.). In: *International Symposium on Remote Sensing of Environment*, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 1. Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 247-259.

Description of the initial concept of the Data Center as a major facility of the ground data handling system for handling data obtained from the earth resources satellites. Within this Center a variety of functions will be performed on the data collected by the satellites in order to provide users with the resources data they want in the desired formats. These functions include initial processing, reproduction, indexing, storage, retrieval, and dissemination of the data for all users. The Center uses existing capabilities and organizations, and permits a quick implementation of a system to get resources data to all potential users. This Center will be the foundation upon which a more complete future system including automatic data processing, enhancement, and analysis will be built. O.H.

A70-26959 * # An experimental evaluation of the basic assumptions used in the analysis of microwave radiometric ground truth data. Ronald J. Hruby, Boris Ragert (NASA, Ames Research Center, Moffett Field, Calif.), and Alvin T. Edgerton (Aerojet-General Corp., Space Div., El Monte, Calif.). In: *International Symposium on Remote Sensing of Environment*, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 1.

Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 587-602. 5 refs.

Results of an experimental program designed to test the validity of commonly made assumptions used in microwave radiometry. These assumptions concern the interpretation and analysis of absorptivity, emissivity, and reflectivity data used in earth resource remote sensing applications. The emissivity and absorptivity data agreed with each other to a sufficient degree of accuracy to ensure confidence in the assumptions and analytical procedures used for rough radiometric applications such as gross imaging, but there were sufficient discrepancies from surface effects and procedures to raise some questions about interpretations of measurements of small temperature differences for moisture content analysis or geological structure. F.R.L.

A70-28987 # Quantitative one-emulsion or one-TV-tube colorimetry of the earth. Georges Courtès (CNRS, Laboratoire d'Astronomie Spatiale, Marseille, France). (*British Interplanetary Society, International Summer School on Earth Observation Satellites*, Cambridge, England, July 14-25, 1969.) *British Interplanetary Society, Journal*, vol. 23, May 1970, p. 357-362. 7 refs.

Outline of a method of improving quantitative colorimetry data with direct digitalization. It is shown that such data can be improved by separating signals of each bandwidth on one photographic emulsion or one TV tube, instead of employing the conventional methods using three emulsions or three TV tubes. Using this new proposed method, five bandwidths or complete spectra can be simultaneously obtained. A.B.K.

A70-29614 # Communication system configuration for the earth resources satellite. G. R. Welti and S. H. Durrani (COMSAT Laboratories, Clarksburg, Md.). *American Institute of Aeronautics and Astronautics, Communications Satellite Systems Conference*, 3rd, Los Angeles, Calif., Apr. 6-8, 1970, Paper 70-326. 14 p. 9 refs. Members, \$1.00; nonmembers, \$1.50.

The communications requirements of the earth resources disciplines and other programs for the 1970s are estimated. Several methods of providing a continuous real-time wideband communication link between the earth resources satellite and a central ground station using relay satellites are considered. The feasibility of using commercial communication satellites is examined. It is found that INTELSAT IV (to be launched in 1971) can provide data links with mission spacecraft and data collection platforms, but that a modified INTELSAT IV would be needed for a television link. Other systems examined employ dedicated medium-altitude satellites, and shared synchronous-altitude commercial satellites. An example of a shared system is presented which is capable of serving earth resources satellites, in-situ data collection platforms, and manned space stations, as well as providing communications services to other users. (Author)

A70-34313 # Speculations on the application of pattern recognition techniques to Earth Resource Satellite data. B. M. Watrasiewicz and M. P. Barton (British Aircraft Corp., Ltd., Bristol, England). (*British Interplanetary Society and NATO, International Summer School on Earth Resources Survey Satellites*, Gonville and Caius College, Cambridge, England, July 14-25, 1969, Paper.) *British Interplanetary Society, Journal*, vol. 23, July 1970, p. 487-494. 6 refs.

Description of two techniques for automatic speech recognition and of two techniques for the automatic tracking of moving objects, which may have application to the processing of data from earth resources satellites. The equipment consists of two principal parts, a signal analyzer and a learning network. Both electronic and optical methods used for speech recognition seem to be suitable in automatic sorting of spectral signatures of various earth resources. Using optical filters, it is possible to track star constellations and thus achieve rocket or satellite attitude stabilization. M.M.

A70-34620 Application of optical filtering to the study of aerial photographs. R. Chevallier (Ecole Pratique des Hautes Etudes, Paris, France), A. Fontanel, G. Grau (Institut Français du Pétrole, Rueil-Malmaison, Hauts-de-Seine, France), and M. Guy (Ecole Nationale Supérieure du Pétrole et des Moteurs à Combustion Interne, Rueil-Malmaison, Hauts-de-Seine, France). (*Société Française de Photogrammétrie, Bulletin*, Oct. 1968.) *Photogrammetria*, vol. 26, June 1970, p. 17-35. 12 refs. Translation.

Description of experiments in which optical filtering techniques were applied to facilitate analysis and interpretation of aerial photographs for acquisition of oceanographic, archaeological, and town planning data. The technical problems arising in the process are discussed and are illustrated by specific examples. Suggestions are given as to how optical filtering and spectral studies can be effectively used in these applications. V.Z.

A70-38755 # Mathematical treatment of satellite photographs of clouds (Matematicheskaya obrabotka sputnikovyykh fotografii oblachnosti). K. S. Shifrin and Iu. S. Fridman (Glavnaia Geofizicheskaya Observatoriia, Leningrad, USSR). *Meteorologiya i Gidrologiya*, June 1970, p. 25-34. 15 refs. In Russian.

Outline of geometric techniques of studying satellite TV pictures of clouds given in a digital representation. Algorithms for tracing contour lines, brightness level lines and their positions with respect to each other are developed. Sets of cloud shape parameters are suggested to obtain geometrical configurations of random form for cloud picture analysis. Examples are given for statistical treatment of cloud picture analysis. Examples are given for statistical treatment of cloud pictures and their machine classification. V.Z.

A70-39058 Ground data processing considerations for earth resource information. Leonard E. Mumbower (IBM Corp., Federal Systems Div., Gaithersburg, Md.). In: Princeton University, Conference on Aerospace Methods for Revealing and Evaluating Earth's Resources, Princeton University, Princeton, N.J., September 25, 26, 1969, Proceedings. Edited by J. P. Layton. Princeton, N.J., Princeton University Conference, 1970, p. 8.1-8.26.

Discussion of system techniques for processing data in image formats acquired from sensors mounted in aerospace platforms. These techniques include collection control, image processing, storage and retrieval, data extraction, and user application. The concepts discussed are based on the successful implementation of similar systems by IBM during the past several years and on the results of investigations which have analyzed the objectives and requirements for handling earth resource information. G.R.

A70-39059 User data processing requirements. Herbert Gurk (RCA, Astro-Electronics Div., Hightstown, N.J.). In: Princeton University, Conference on Aerospace Methods for Revealing and Evaluating Earth's Resources, Princeton University, Princeton, N.J., September 25, 26, 1969, Proceedings. Edited by J. P. Layton. Princeton, N.J., Princeton University Conference, 1970, p. 9.1-9.13; Discussion, p. 9.14, 9.15.

Discussion of the requirements of the users of data obtained by the Earth Resources Satellite giving particular attention to requirements for special processing. Data processing for Resources Satellite users is examined. Common user requirements are separated into two different types of functions involving initial processing and additional processing. Some typical applications are considered and the interpretability of features is discussed. Aspects of partitioning and mosaicking are investigated. G.R.

A70-41403 Internal and integral photointerpretation (Interne und integrale Photointerpretation). H. Schmidt-Falkenberg (Institut für angewandte Geodäsie, Frankfurt am Main, West Germany). *Bildmessung und Luftbildwesen*, vol. 38, Sept. 1, 1970, p. 313-318. 13 refs. In German.

Discussion of the possibility to increase the volume and reliability of information, obtained by specialists in their particular fields of interest, by an 'integral' - i.e., interdisciplinary method of photointerpretation. A set of models is proposed for various structures of the landscape that might serve also as a basis for automated photointerpretation. (Author)

A70-41851 * # Digital computer terrain-mapping from multispectral data. Harry W. Smedes, Kenneth L. Pierce (U.S. Geological Survey, Denver, Colo.), Marc G. Tanguay (Montréal, Université, Ecole Polytechnique, Montréal, Canada), and Roger M. Hoffer (Purdue University, West Lafayette, Ind.). (American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-309.) *Journal of Spacecraft and Rockets*, vol. 7, Sept. 1970, p. 1025-1031. 6 refs. NASA Contract No. R-09-020-015.

Brief description of the preliminary results and current status of studies of digital computer processing of airborne multispectral data, the success of automatic recognition and mapping of the distribution of eight different terrain types, and the effectiveness of the proposed Earth Resources Technology Satellite (ERTS) data channels as compared to the computer-selected best four channels in the automatic recognition and mapping of the same terrain types based on simulations, using the same set of data. This study involves the data from one flight over a test area of about 12 square miles in a region of moderate relief comprising a wide variety of terrain types. The data were acquired and processed in analog form and were then processed in digital form. Only the preliminary study of the digital processing is treated. The following terrain types have been mapped with greater than 80 percent accuracy: bedrock exposures, talus, vegetated rock rubble, glacial kame terrace, glacial till, forest, bog, and water. Shadows of clouds and cliffs are depicted. Simulations resulted in maps whose accuracies were only a few percent less than that using the best set of four channels; they indicate that the ERTS data channels are likely to be successful for terrain analysis of a wide variety of categories encompassing a broad range of spectral reflectance. These studies also indicate that, for a broad range of terrain categories, many combinations of 3 or 4 channels of data would be satisfactory. M.M.

A70-43088 # Spectral signature recognition. D. S. Hanson and R. H. Dye (Bendix Corp., Aerospace Systems Div., Ann Arbor, Mich.). *Bendix Technical Journal*, vol. 3, Summer-Autumn 1970, p. 33-39.

This paper describes the specific techniques involved in spectral signal recognition as well as the problems, potential, and limitations associated with it as a method for automatic interpretation of multispectral data gathered in earth resources exploration. Two of the most difficult problems encountered involve (1) storage of the large amount of information that is required to classify each spectral observation as one of the target alternatives, and (2) accomplishing this classification at an adequate speed. A possible solution to these problems is described in some detail. (Author)

A70-43091 # Channel data rate of the Earth Resources Technology Satellite link. C. R. Tieman (Bendix Corp., Aerospace Systems Div., Ann Arbor, Mich.). *Bendix Technical Journal*, vol. 3, Summer-Autumn 1970, p. 60-62.

Study of the several trade-offs that could be made in the design of the earth-resources technology satellite (ERTS) link, in order to maximize its data transmission capacity within the limitations imposed by system error rate and transmitter power. The results obtained indicate that a multilevel encoding system can be used to achieve a higher PCM data rate on the fixed-bandwidth ERTS channel than is possible using a binary system. This is accomplished, however, either at a sacrifice in bit error rate for a given level of transmitter power or at a sacrifice in transmitter power for a constant error rate. As to the trade-off between channel capacity and transmitter power, it is shown that, at a bit error rate of 0.00001, an octal system requires about 21 times more power than a binary system to achieve a threefold increase in data rate. Similarly, a quaternary system requires five times more power to double the data rate of a binary system. M.V.E.

A70-44514 * # Data management at the National Space Science Data Center. J. I. Vette and N. Karlow (NASA, Goddard Space Flight Center, Greenbelt, Md.). (American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-320.) *Journal of Spacecraft and Rockets*, vol. 7, Oct. 1970, p. 1234-1240. 6 refs.

Discussion of the data management problems of the National Space Science Data Center (NSSDC). Though providing the means

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for the dissemination and analysis of space science data beyond that provided by the original experimenter constitutes its primary function, and NSSDC is therefore not an operational data processing center proper, it nevertheless has to perform rather great data management tasks. These tasks are considerably magnified by NSSDC's secondary functions arising from space science data needs of various user groups other than the principal planners or investigators in the fields concerned. The experiences of NSSDC in these secondary uses of space science data are discussed. With a present annual generation rate of space science information bits of the order of 10 to the 12th power, the data management problems become significant, and considerable data processing is required before maximum utilization of the data base can be realized. In addition, NSSDC must be concerned with an information system to handle documentation, performance data, instrument calibration and characteristics, and management information. M.V.E.

A71-17146 * Earth-resources technology satellite - NASA Data-Processing Facility. Harold H. Levy (NASA, Goddard Space Flight Center, Greenbelt, Md.). (*Institute of Electrical and Electronics Engineers, Annual International Geoscience Electronics Symposium, 2nd, Washington, D.C., Apr. 14-17, 1970.*) *IEEE Transactions on Geoscience Electronics*, vol. GE-8, Oct. 1970, p. 348-352.

The earth-resources technology satellite (ERTS) NASA Data-Processing Facility (NDPF) is organized functionally into two units: (1) the telemetry and image data processing (TIDP) where the bulk of all data are transformed into user-oriented media; and (2) the data services laboratory (DSL) where all production scheduling, accounting, cataloging, storage and retrieval, dissemination, and user services will be performed. The NDPF will be a dedicated facility for doing only ERTS processing and will be collocated with the Operations Control Center (OCC) on the top floor of Building 23 at Goddard Space Flight Center. The facility is being planned to be capable of processing a data volume based on continental U.S. coverage plus 1 hour per day of video data obtained from an on-board wide-band video tape recorder. (Author)

A71-17147 * Spatial registration of multispectral and multi-temporal digital imagery using fast Fourier transform techniques. Paul E. Anuta (Purdue University, West Lafayette, Ind.). (*Institute of Electrical and Electronics Engineers, Annual International Geoscience Electronics Symposium, 2nd, Washington, D.C., Apr. 14-17, 1970.*) *IEEE Transactions on Geoscience Electronics*, vol. GE-8, Oct. 1970, p. 353-368. 9 refs. NASA-supported research; U.S. Department of Agriculture Contracts No. 12-14-100-9549(20); No. 12-14-100-10292(20).

A system for spatial registration of digitized multispectral and multi-temporal imagery is described. Multispectral imagery can be obtained from sources such as multilens cameras, multichannel optical-mechanical line scanners, or multiple vidicon systems which employ filters or other spectral separation techniques to sense selected portions of the spectrum. Spatial registration is required so that multidimensional analysis can be performed on contextually similar image elements from different wavelength bands and at different times. The general registration problem is discussed first; then the fast Fourier transform (FFT) technique for cross correlation of misregistered imagery to determine spatial distances is discussed in detail. A method of achieving translational, rotational, and scaling corrections between images is described. Results of correlation analysis of multispectral scanner imagery and digitized satellite photography is presented. Use of the system for registration of multispectral airborne line-scanner imagery and space photography is described. Application of the techniques to preprocessing of earth resources satellite imagery from systems such as the earth-resources technology satellite (ERTS) scanner and vidicon system is discussed in conclusion. (Author)

A71-18802 User requirements for Earth Resources Satellite data. Peter Wood (Mitre Corp., McLean, Va.). In: *EASCON '70*; Institute of Electrical and Electronics Engineers, Electronics and

Aerospace Systems Convention, Washington, D.C., October 26-28, 1970, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1970, p. 14-20. 9 refs.

This paper is concerned with the needs of the multiplicity of individual users of satellite data, each of whom not only is frequently concerned with a limited geographical area but also usually has fairly specific requirements. The needs of the individual user in terms of format and presentation are discussed on the basis of an investigation which has been carried out using various types of spacecraft and simulated spacecraft data. An outline of the various techniques that are available for supplying the user with the information he requires is given. The application of Earth Resources Technology Satellite data to forest inventory is described. G.R.

A71-18804 Earth Resources Technology Satellite System data processing. E. P. McMahon (General Electric Co., Riverdale, Md.). In: *EASCON '70*; Institute of Electrical and Electronics Engineers, Electronics and Aerospace Systems Convention, Washington, D.C., October 26-28, 1970, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1970, p. 24-27.

The Earth Resources Technology Satellite (ERTS) System will collect multispectral data of the earth's surface for processing and distribution to various users. This paper presents the data flow and characteristics of the data which will be processed in the NASA Data Processing Facility of the ERTS System. (Author)

A71-18806 Operational processing of environmental satellite data. John A. Leese (ESSA, Suitland, Md.). In: *EASCON '70*; Institute of Electrical and Electronics Engineers, Electronics and Aerospace Systems Convention, Washington, D.C., October 26-28, 1970, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1970, p. 53, 54.

Emphasis in this paper is on the procedures used to process and extract information from the satellite data received at the National Environmental Satellite Center as an on-line operation. These include the gridding and mapping of the visible and infrared imagery, manual analysis and interpretation of cloud pictures and the use of automated procedures to derive quantitative information from satellite data. Examples of the products will be shown and discussed in terms of their applications to such items as weather forecasting. (Author)

A71-20691 Data requirements and data processing earth resources surveys. Roger A. Holmes (Purdue University, Lafayette, Ind.). *SPIE Journal*, vol. 9, Dec.-Jan. 1971, p. 52-56.

Description of a remote sensing system for earth resources surveys which employs the human interpreter for spatial data processing tasks and the machine for spectral data processing tasks in a way that makes rapid extraction of information possible. The prime concentration is on agricultural requirements. Spectral radiance recording of agricultural scenes is carried out using an airborne multispectral optical-mechanical scanner for gathering spectral radiance data in many bands. Scene radiance data are recorded on magnetic tape so that each location along the tape contains the spectral information, one band per track, while the location along a given track contains the spatial distribution of a band radiance in a scan raster line. To handle the data from the scanner output tape recording, an analog-to-digital conversion system is used which samples an analog flight tape in twelve bands, resolution element by resolution element, and packs this on a digital tape at a rate of 100,000 eight-bit per sec. For data analysis, a spectral pattern recognition technique is employed. Using this technique, spectral pattern can automatically be recognized and thus resolution patches as to crop can be classified. Several examples are presented. O.H.

A71-21250 DoD data processing equipment for radar imagery. M. V. Jonah and Carmen DiCarlo (U.S. Department of Defense, Defense Intelligence Agency, Washington, D.C.). In:

American Society of Photogrammetry and American Congress on Surveying and Mapping, Technical Conference, Denver, Colo., October 7-10, 1970, Proceedings. Falls Church, Va., American Society of Photogrammetry, 1970, p. 207-232.

It is pointed out that for many years the Department of Defense has needed a capability for airborne, terrain-imaging radar as a mapping sensor because of its inherent all-weather capability. A radar investigation for mapping, and study programs initiated to determine optimum types of airborne and ground-based equipment, are considered. Particular attention is given to R and D progress to date on the radar ground data processing equipment such as correlators, orthographic restitutor, and stereo equipment. G.R.

A71-21255 Digital image processing for terrain pattern recognition. Lawrence P. Murphy (U.S. Army, Engineer Topographic Laboratories, Fort Belvoir, Va.). In: American Society of Photogrammetry and American Congress on Surveying and Mapping, Technical Conference, Denver, Colo., October 7-10, 1970, Proceedings. Falls Church, Va., American Society of Photogrammetry, 1970, p. 324-354. 6 refs.

The U.S. Army Engineer Topographic Laboratories have evaluated and tested a prototype digital image processing system for performing pattern recognition experiments. Tests and procedures are described for evaluating the Natural Image Computer (NIC) with its systems software, in addition to the conclusions reached from the analysis. The prototype system was designed as an exploratory laboratory device for pattern recognition studies and limited feature delineation capability using vertical aerial photography as an input. The structure of the recognition algorithms is based upon recognition and correlation to basic feature shapes and statistical characteristics of the grey scale distribution of Military Geographic Intelligence. The NIC is a versatile laboratory device capable of accepting cut film photographs and producing grey scale digitization of the imagery at 16, 32, and 64 grey scale levels. (Author)

A71-26639 # Results of observations of the thermal radio emission from the earth's surface on the basis of data from the Cosmos-243 experiment (Rezultaty nabludeniia teplovogo radioizlucheniia zemnoi poverkhnosti po dannym eksperimenta na ISZ 'Kosmos-243'). A. E. Basharinov, A. S. Gurvich, S. T. Egorov, V. I. Zhukov, A. A. Kurskaia, L. I. Malafeev, D. T. Matveev, A. S. Mikhailov, and A. M. Shutko. *Kosmicheskie Issledovaniia*, vol. 9, Mar.-Apr. 1971, p. 268-279. 15 refs. In Russian.

Satellite measurements of the earth's thermal radiation are analyzed, showing that uhf radiometry data make it possible to determine the temperature conditions, water areas, ice fields, and various land areas. Radio brightness profiles of water areas and typical mountainous, desert, and ice-covered areas are presented and discussed. V.P.

A71-30912 * The telecommunication system for the Earth Resources Technology Satellite (ERTS) A and B. Marvin Maxwell and John Pandelides (NASA, Goddard Space Flight Center, Greenbelt, Md.). In: NTC '71; Institute of Electrical and Electronics Engineers, National Telemetering Conference, Washington, D.C., April 12-15, 1971, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 137-147. 7 refs.

The Earth Resources Technology Satellite mission is to acquire high resolution multispectral image data in the visible and IR for earth resource management in areas such as agriculture, hydrology, cartography, and oceanography. The communications system uses both the Manned Space Flight Network and the Space Tracking and Data Acquisition Network for tracking, data acquisition and commanding. A 3 camera high resolution Return Beam Vidicon system sequentially transmits a dc to 3.2 MHz analog base-band signal. Data from a Multispectral Scanning radiometer sensed in four spectral bands is transmitted at 15 megabits per second. A pair of redundant Video Tape Recorders store either of the sensors data. The experiment payload incorporates a Data Collection System capable of acquiring data from up to 1000 fixed low power platforms every

12 hours. Communication link analysis indicates that adequate signal-to-noise margins exist for all nominal modes of operation.

(Author)

A71-30913 World Weather Watch global telecommunications. John C. Straiton (U.S. Weather Bureau, Silver Spring, Md.). In: NTC '71; Institute of Electrical and Electronics Engineers, National Telemetering Conference, Washington, D.C., April 12-15, 1971, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 148-152.

The evolving Global Telecommunications System of the World Weather Watch is described in this paper as one of the World's most extensive and far flung telemetry systems. Telemetry is employed in determining the state of the atmosphere on the ground with the AMOS, on the sea using the MAMOS, up through the atmosphere using a balloon or rocket borne radiosonde, and from satellite borne sensors circling high above the earth's surface and from 'stationary' satellites very high above the atmosphere. The various courses of these automatically sensed data are traced through the various telemetry links from the source until they become an integral part of a meteorological analysis or prognosis (forecast for a forecaster) which in due time is delivered to the human user perhaps half a world away. (Author)

A71-34271 Optical processing for pattern properties. Sten Nyberg, Torleiv Orhaug (Färsvarets Forskningsanstalt, Stockholm, Sweden), and Harald Svensson (Lunds Universitet, Lund, Sweden). *Photogrammetric Engineering*, vol. 37, June 1971, p. 547-554.

The method of using coherent optics for generating Fourier transforms of pictorial information is applied to imageries obtained in earth sciences. The invariance of different properties of linear structures in a two-dimensional pattern is discussed both mathematically and experimentally. Five samples of images of interest to earth sciences are investigated by this method. The properties of the structural information thus obtainable from the patterns are discussed in some detail. It is concluded that this method of image processing may be useful for investigating two-dimensional structures and for measuring their properties. (Author)

A71-34273 An electronic multi-image processor. John E. Estes and Leslie W. Senger (California, University, Santa Barbara, Calif.). *Photogrammetric Engineering*, vol. 37, June 1971, p. 577-579. 580-586. 10 refs. Grant No. DA-AK-2-67-C-0435.

A new system, called IDECS, which is an acronym for 'image discrimination, enhancement, combination and sampling', has been developed at the University of Kansas as a versatile research tool to be used for interpretation of multiband imagery. A comparative one-way analysis-of-variance test sequence was performed to relate interpretability of imagery obtained with this system to that of comparable images produced by other multispectral combiners and by filtered panchromatic and color films. The experimental hypothesis was that different types of imagery exhibit different degrees of interpretability for particular earth features. Interpreters of various levels of skill were tested in terms of correct responses, omission error committed and commission errors committed for features in diverse environments. Results of the experiments indicate that IDECS is competitive with other enhancement and photographic systems as an aid to interpretation of earth features. O.H.

A71-34611 Earth Resources Technology Satellite system. B. T. Bachofer (GE Space Center, Valley Forge, Pa.). In: Institute of Electrical and Electronics Engineers and Western Electronic Manufacturers Association, Western Electronic Show and Convention, Los Angeles, Calif., August 25-28, 1970, Proceedings. North Hollywood, Calif., Western Periodicals Co. (WESCON Technical Papers. Volume 14), 1970, p. 13/2 1-13/2 9.

A system overview is provided giving attention to the observatory system, the operations control center, and the NASA data processing facility. Several aspects of the system design result from

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relatively unique mission requirements. It is necessary to establish and maintain a precise orbit. The need for a wideband communication system compatible with high data rates from two multispectral sensors with significantly different data characteristics is considered, and approaches envisioned in connection with the requirement to accurately locate imagery to an earth based reference grid within 2 nautical miles is discussed. G.R.

A71-35429 # ERTS remote sensor data processing - The key to a space application. I. S. Haas (General Electric Co., Space Div., Philadelphia, Pa.). *American Institute of Aeronautics and Astronautics, Space Systems Meeting, Denver, Colo., July 19, 20, 1971, Paper 71-839*. 12 p. Members, \$1.50; nonmembers, \$2.00.

Review of the ERTS space and ground equipment and techniques to be used in the transmission to earth of the raw output of the sensors and in the reduction of the material to useful data and its mass reproduction. Following a makeup outline of the ERTS spacecraft, its wideband telemetry, telemetry tracking and command, orbit adjustment, power, and attitude control subsystems are briefly described. The ERTS ground data processing problem is then discussed in terms of the factors involved in geometric and radiometric data accuracy and of its external, internal, and positional sources of error. The concluding description of the ground data-handling system covers the NASA data processing facility and its bulk processing, precision processing, digital processing, photographic processing, and high-throughput reproduction subsystems.

M.V.E.

A71-35774 A versatile technique for the automatic extraction of information from reconnaissance images. Glenn E. Tisdale (Westinghouse Defense and Space Center, Baltimore, Md.). In: *NAECON '71; Institute of Electrical and Electronics Engineers, National Aerospace Electronics Conference, Dayton, Ohio, May 17-19, 1971, Proceedings*. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 166-171.

Extraction of information from reconnaissance images involves several related operations, including the location and identification of specific target classes or terrain configurations, and the registration between images of the same scene for purposes of accurate positioning, multisensor evaluation, or change detection. Complications are introduced, because images may be obtained from sensors having different spectral sensitivity and under various conditions of illumination, orientation, scale, and aspect angle. This paper describes a digital image processing technique that performs operations of this kind automatically, under realistic conditions. It is, in essence, a pattern recognition technique. Although its operation is currently being computer-simulated, it is intended for implementation as a compact, special-purpose processor, having an overall rate of operation exceeding one picture element per microsec. (Author)

A71-36067 On bridging the gap between raw remote-sensor data and resource and environmental information. Bernardo F. Grossling and John E. Johnston (U.S. Geological Survey, Washington, D.C.). In: *Photo-optical instrumentation for the 70's; Society of Photo-optical Instrumentation Engineers, Annual Technical Symposium, 15th, Anaheim, Calif., September 14-17, 1970, Proceedings*.

Symposium co-sponsored by the U.S. Air Force and the U.S. Army. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers (SPIE Annual Technical Symposium Proceedings. Volume 3), 1971, p. 179-188.

Discussion of the economic justification for the gathering of raw remote-sensor data, and of its interpretation so that it becomes useful for public and private users. A wide gap exists between raw remote-sensor data, such as photographs, sensor imageries, line scans, or point measurements, and resource information as needed by various units of a nation's economy. Vast amounts of remote-sensor data bearing on earth resources and environment will be collected repetitively in the near future. Thus a careful consideration should be given to the overall data-processing system that underlies the gathering and utilization of such information. Such a system encompasses a large variety of governmental and private entities.

F.R.L.

A71-36082 Pictorial noise evaluation in space imagery. Jack J. O. Palgen (Allied Research Associates, Inc., Lanham, Md.). In: *Photo-optical instrumentation for the 70's; Society of Photo-optical Instrumentation Engineers, Annual Technical Symposium, 15th, Anaheim, Calif., September 14-17, 1970, Proceedings*.

Symposium co-sponsored by the U.S. Air Force and the U.S. Army. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers (SPIE Annual Technical Symposium Proceedings. Volume 3), 1971, p. 409-417. 15 refs.

A two-dimensional optical Fourier approach is proposed for diagnosing interpretation-limiting pictorial noise patterns often present in satellite image output. Concepts are discussed that make it possible to have the diagnosed pictorial noise provide parameters for cleaning the image with a minimum of information loss and/or aliasing. These concepts are expected to be directly useful to the cleaning and interpretation of ERTS images. M.V.E.

A71-36084 Enhancing aerospace imagery for visual interpretation. Donald S. Ross (International Imaging Systems, Mountain View, Calif.). In: *Photo-optical instrumentation for the 70's; Society of Photo-optical Instrumentation Engineers, Annual Technical Symposium, 15th, Anaheim, Calif., September 14-17, 1970, Proceedings*.

Symposium co-sponsored by the U.S. Air Force and the U.S. Army. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers (SPIE Annual Technical Symposium Proceedings. Volume 3), 1971, p. 435-443. 22 refs.

Discussion of some of the problems and problem solutions associated with the need of delivering to users ERTS images displaying information in its most readable form for specific applications. These problems are compounded by the nature of synoptic imagery, in that scale and ground resolution are several orders less than the average interpreter is used to analyzing, since each frame covers thousands of square miles. Various techniques are reviewed that, by amplifying visually indistinguishable differences to visual detection level, aid image information extraction. Some of these so-called image-enhancement techniques are reviewed. The Sabatier and Clayden effects, the Agfa-Gevaert equi-density contour film, and masking are discussed in connection with techniques based on photographic processes. Image-enhancement methods using optical, color, and electronic devices conclude the discussion. M.V.E.

A71-36472 Probability of a clear line-of-sight through the atmosphere for a satellite-based laser communications system - A feasibility study. Richard A. Brintzenhofe, James L. Cox, James T. Williams (NOAA, Spaceflight Meteorology Group, Suitland, Md.), and Charles J. Neumann (NOAA, Spaceflight Meteorology Group, Miami, Fla.). In: *Technology today and tomorrow; Canaveral Council of Technical Societies, Space Congress, 8th, Cocoa Beach, Fla., April 19-23, 1971, Proceedings. Volume 1*.

Edited by N. A. Stein. Cape Canaveral, Canaveral Council of Technical Societies, 1971, p. 10-23 to 10-51. 10 refs.

Study of the effect of clouds on laser transmissions from space. To obtain an indication of the receiving capabilities for a selection of ground receiving stations, a preliminary evaluation of the monthly mean percentage-of-possible sunshine statistics was made. This evaluation indicated a high probability of data receipt via laser communications. To test more rigorously the capability of a network of six ground stations optimally placed, and to consider only the planned (morning) hours of ERTS (Earth Resources Technology Satellite) passage, a simulated operation used five years of January and July data. The simulations involved a series of hypothetical satellite crossings over the U.S. Results from the simulated operations indicate that, with the capability of choosing one from usually three or more ground stations for each satellite passage, clear line-of-sight probabilities are sufficiently high to support the concept of laser communications between space and earth. M.M.

A71-36501 Space and communication: Acquisition and transmission of data in space applications systems; Union des Associations Techniques Internationales and Société Française des

Electroniciens et des Radioélectriciens, International Conference, Paris, France, March 29-April 2, 1971, Communications. Volumes 1 & 2 (L'espace et la communication: Collecte et transmission de l'information dans les systèmes spatiaux d'application; Union des Associations Techniques Internationales and Société Française des Electroniciens et des Radioélectriciens, Colloque International, Paris, France, March 29-April 2, 1971, Communications. Volumes 1 & 2). Colloquium co-sponsored by the Fédération Nationale des Industries Electroniques and the Centre National d'Etudes Spatiales. Paris, Comité d'Organisation du Colloque de Paris, 1971. Vol. 1, 617 p.; vol. 2, 482 p. In French and English.

The articles deal with the role of large international organizations in the field of space and communications, sound and television broadcasting with the aid of satellites, satellite controlled air navigation systems (in particular, the Dioscures project), subsystems figuring in satellite controlled air navigation systems, the development of telecommunication systems, a detailed description of telecommunication systems using the Sirio and Symphonie satellites, the reliability and fabrication of satellite components, earth resources technology satellites (ERTS-A and ERTS-B), and the use of satellites in meteorological, geodetic, and aircraft tracking observations.

A.B.K.

A71-36540 Processing of images transmitted from earth resources observation satellites. L. Kuehn, E. R. Omberg, and G. Forry (TRW Systems Group, Redondo Beach, Calif.). In: Space and communication: Acquisition and transmission of data in space applications systems; Union des Associations Techniques Internationales and Société Française des Electroniciens et des Radioélectriciens, International Conference, Paris, France, March 29-April 2, 1971, Communications. Volume 1 (L'espace et la communication: Collecte et transmission de l'information dans les systèmes spatiaux d'application; Union des Associations Techniques Internationales and Société Française des Electroniciens et des Radioélectriciens, Colloque International, Paris, France, March 29-April 2, 1971, Communications. Volume 1). Colloquium co-sponsored by the Fédération Nationale des Industries Electroniques and the Centre National d'Etudes Spatiales. Paris, Comité d'Organisation du Colloque de Paris, 1971, p. 556-564.

A rectilinear procedure for correction of geometric errors by means of a digital computer is described. Simultaneous corrections accounting for internal consistency, absolute geometry, and map projections are made. Radiometric compensations may also be entered without significantly altering processing times. An image containing different regions, each element of which belongs to a common class, may be partitioned by examining every pixel in accordance with various a priori spectral signatures. A more efficient procedure operates by rapidly scanning across the image until a border point is detected and then tracked until it closes upon itself or terminates at the scene perimeter, the process being repeated until all borders are identified. The border following algorithm examines a matrix of eight surrounding pixels in order to determine the maximum likelihood direction of the next border point and makes a logical decision. The computer-aided analysis of data is briefly examined.

Z.W.

A71-36541 The 'data processing center' of the earth resources satellites ERTS-A and B (Le 'centre de traitement de l'information' des satellites de ressources terrestres ERTS-A et B). J. J. O. Palgen (Allied Research Associates, Inc., Lanham, Md.) and W. Phucas (General Electric Co., Space Div., Philadelphia, Pa.). In: Space and communication: Acquisition and transmission of data in space applications systems; Union des Associations Techniques Internationales and Société Française des Electroniciens et des Radioélectriciens, International Conference, Paris, France, March 29-April 2, 1971, Communications. Volume 1 (L'espace et la communication: Collecte et transmission de l'information dans les systèmes spatiaux d'application; Union des Associations Techniques Internationales and Société Française des Electroniciens et des

Radioélectriciens, Colloque International, Paris, France, March 29-April 2, 1971, Communications. Volume 1).

Colloquium co-sponsored by the Fédération Nationale des Industries Electroniques and the Centre National d'Etudes Spatiales. Paris, Comité d'Organisation du Colloque de Paris, 1971, p. 565-574. In French.

Description of the organization and activities of the data processing center handling pictorial data obtained by the earth resources satellites ERTS-A and ERTS-B. The manner in which the pictorial data are to be acquired by the two satellites is reviewed. The various functions performed at the data processing center are summarized, noting the scope of the production and distribution aspects of the work, and the system of image processing employed is explained in detail. Services available to users are indicated, and the possibility of international participation is considered.

A.B.K.

A71-36542 Numerical treatment of data obtained by satellites - Pictorial noise (Traitement numérique de l'information recueillie par satellites - Les bruits pictoriaux). J. J. O. Palgen (Allied Research Associates, Inc., Lanham, Md.). In: Space and communication: Acquisition and transmission of data in space applications systems; Union des Associations Techniques Internationales and Société Française des Electroniciens et des Radioélectriciens, International Conference, Paris, France, March 29-April 2, 1971, Communications. Volume 1 (L'espace et la communication: Collecte et transmission de l'information dans les systèmes spatiaux d'application; Union des Associations Techniques Internationales and Société Française des Electroniciens et des Radioélectriciens, Colloque International, Paris, France, March 29-April 2, 1971, Communications. Volume 1). Colloquium co-sponsored by the Fédération Nationale des Industries Electroniques and the Centre National d'Etudes Spatiales. Paris, Comité d'Organisation du Colloque de Paris, 1971, p. 575-584. 8 refs. In French.

Consideration of the problem of eliminating so-called picture noise from the pictorial data obtained by the proposed earth resources satellites ERTS-A and ERTS-B. The data acquisition system to be used in connection with these satellites is described, and certain work done in the field of noise diagnosis and the defining of numerical methods of eliminating parasitical effects is cited. The difficulties confronting ERTS utilizers are illustrated by an example concerning the acquisition of images gathered by the high-resolution IR radiometer of the Nimbus 3 satellite. Both a one-dimensional and a two-dimensional method of filtering out picture noise in the Nimbus images are described. It is concluded that the subsystem required for operational filtering of ERTS images must be a compromise between these two methods.

A.B.K.

A71-39685 # The results of microwave sounding of the earth's surface according to experimental data from the satellite Cosmos 243. A. E. Basharinov, A. S. Gurchik, S. T. Egorov, A. A. Kurskaia, D. T. Matveev, and A. M. Shutko (Akademiya Nauk SSSR, Moscow, USSR). In: Space research XI; COSPAR, Plenary Meeting, 13th, and Symposium on Remote Sounding of the Atmosphere, Leningrad, USSR, May 20-29, 1970, Proceedings. Volume 1.

Meeting and Symposium co-sponsored by the International Union of Geodesy and Geophysics and the World Meteorological Organization. Edited by K. Ia. Kondrat'ev, M. J. Rycroft, and C. Sagan. Berlin, East Germany, Akademie-Verlag, 1971, p. 713-716.

Results of an experiment in measuring microwave emission from the Cosmos 243 satellite with four radiometers at wavelengths of 0.8, 1.35, 3.5, and 8.5 cm. The intensity of microwave emissivity variations of the sea surface is estimated, and the boundary of the domains of floating ice near the Antarctic continent is determined. Radio brightness variations dependent on latitude and local features

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for Australia, the Antarctic continent, the Sahara zone, and other areas are detected, and a decrease in the radio brightness temperature and emissivity by 20 to 30% in zones of high humidity is noted.

A.B.K.

A71-39686 # The use of infrared imagery from meteorological satellites for the study of the earth's surface. A. A. Grigor'ev, V. B. Lipatov, and B. V. Vinogradov (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR). In: Space research XI; COSPAR, Plenary Meeting, 13th, and Symposium on Remote Sounding of the Atmosphere, Leningrad, USSR, May 20-29, 1970, Proceedings. Volume 1. Meeting and Symposium co-sponsored by the International Union of Geodesy and Geophysics and the World Meteorological Organization. Edited by K. Ia. Kondrat'ev, M. J. Rycroft, and C. Sagan. Berlin, East Germany, Akademie-Verlag, 1971, p. 723-725.

An example is given of integrated interpretation of a matrix-map of effective temperatures and of an infrared picture (8-12 microns) of the area of middle Asia and Kazakhstan obtained from the meteorological satellite Meteor 2. The thermal nonuniformities of different areas of the earth's surface and of cloudiness are seen in the infrared picture as spots of different tones, sizes and configuration. Analysis shows some of the factors influencing the thermal patterns of different natural formations. (Author)

A71-41987 # Planning for a global remote-sensing information system. J. M. Harrison, L. W. Morley (Department of Energy, Mines and Resources, Ottawa, Canada), and A. F. Gregory. *International Astronautical Federation, International Astronautical Congress, 22nd, Brussels, Belgium, Sept. 20-25, 1971, Paper. 15 p.*

Outline of a proposed organization for planning a global remote-sensing information system operated and financed through international cooperation. The objective of the system would be to provide and distribute in an equitable, timely, and effective manner the remotely sensed data and derived information needed for the management of the resources and environment of participating nations. The system would coordinate the collection, processing, and interpretation of such data for the optimum benefit of individual states and the world at large. The technical development of such a system is considered on the basis of experience gained with a similar national structure in Canada. It is urged that a small technically oriented task force be set up within the framework of the U.N. to prepare the initial plans for an international system. The duties of this task force are outlined, and a hypothetical schedule of functions is advanced. T.M.

A71-42018 * # Ground data handling for the earth resources technology satellites, ERTS-A and -B. Wilfred E. Scull (NASA, Goddard Space Flight Center, Greenbelt, Md.). *International Astronautical Federation, International Astronautical Congress, 22nd, Brussels, Belgium, Sept. 20-25, 1971, Paper. 21 p.*

Discussion of the operations and equipment of the NASA Ground Data Handling System being constructed for processing and dissemination of Earth Resources Technology Satellites (ERTS-A and -B) data. Details are given on the satellites, the Operations Control Center and the Data Processing Facility of the project. Bulk processing, precision processing and special processing operations are covered. V.Z.

A71-43012 # Earth dynamic filtering of geodetic data. Paul Menemeyer (Colorado State University, Fort Collins, Colo.). *American Astronautical Society and American Institute of Aeronautics and Astronautics, Astrodynamics Specialists Conference, Ft. Lauderdale, Fla., Aug. 17-19, 1971, AAS Paper 71-339. 19 p. 48 refs.*

Equations describing the earth's rotational and deformational motion have been included directly in an extended Kalman-Schmidt

filter designed to process geodetic data. The necessity for assuming constant polar motion coordinates and tidal deformation parameters over limited time intervals is thereby circumvented, and dynamical constraints on the earth's motion affect evolution of the state vector at each step in the recursion. The filter can be applied to data produced by any geodetic instrument whose dynamical properties can be represented analytically. Of particular interest are measurements made using geodetic satellites. The accuracy of such measurements is now on the order of one meter and it is expected that observations will soon be made at the 2 cm level using the 'Cannonball,' 'Geopause,' and 'drag free' satellites. Computer simulation indicates that application of the earth-dynamic filter to data of this quality will permit near real-time resolution of fine structure in the polar motion, tidally induced changes in the geopotential, and short period variations in station coordinates due to tidal deformation or oscillations of the earth following a major earthquake. (Author)

A71-44575 # Design of the ERTS image processing system. R. Johnson and R. Buiten (Bendix Corp., Aerospace Systems Div., Ann Arbor, Mich.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 8th, Washington, D.C., Oct. 25-28, 1971, Paper 71-977. 13 p. Members, \$1.50; nonmembers, \$2.00.*

This paper describes the design of the Image Processing System (IPS) for the Earth Resources Technology Satellite (ERTS). The ERTS IPS converts videotape recordings of Return Beam Vidicon (RBV) and Multispectral Scanner (MSS) video into film and computer-compatible tapes useful to ERTS users or investigators. The IPS has been designed to be responsive to the varied needs of these users, and to preserve the inherent quality of the sensor's signals, correct for systematic errors, provide adequate throughput, and produce timely products. The design features of the IPS include the Electron Beam Recorder, and its image corrector, precision electrooptical systems to measure and correct geometric and radiometric distortions, and special digital processors to correct and convert video data into computer tape formats. (Author)

A71-44576 # Digital techniques for earth resource image data processing. R. Bernstein (IBM Corp., Federal Systems Div., Gaithersburg, Md.) and H. Silverman (IBM Thomas J. Watson Research Center, Yorktown Heights, N.Y.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 8th, Washington, D.C., Oct. 25-28, 1971, Paper 71-978. 15 p. 20 refs. Members, \$1.50; nonmembers, \$2.00.*

Description of techniques for implementing image corrections and of results of image processing experiments. The techniques include methods for automatically locating resseau marks and reference ground-control points, and for computing and applying both geometric and radiometric image corrections. A fast method of correlation (based on a class of sequential-similarity-detection algorithms) which solves the problem in digital image processing of correlating the working image to a reference image is presented. M.M.

A71-45294 # Earth resources satellite ground data management with special emphasis on ERTS ground data handling system. G. Paul Fishman (General Electric Co., Space Div., Philadelphia, Pa.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 8th, Washington, D.C., Oct. 25-28, 1971, Paper 71-976. 12 p. Members, \$1.50; nonmembers, \$2.00.*

A general overview is given of the Earth Resources Technology Satellite (ERTS) system and program which has been designed as a research and development tool to demonstrate that remote sensing from space is a practical technique in management of the earth's resources. A discussion is presented of the critically important path that ERTS data will follow, from the raw output of the sensors, transmission to earth, relay to the data processing facility at Goddard Space Flight Center and, finally, delivery to the investigators and user agencies. Special emphasis is placed on the data processing,

correction, reproduction, storage, retrieval and distribution functions performed on the ground. O.H.

A72-10449 Photogrammetric evaluation for use of RBV images from ERTS. R. B. McEwen (U.S. Geological Survey, McLean, Va.). In: American Society of Photogrammetry, Fall Convention, Symposium on Computational Photogrammetry, San Francisco, Calif., September 7-11, 1971, Proceedings. Falls Church, Va., American Society of Photogrammetry, 1971, p. 70-82.

Description of photogrammetric and cartographic evaluations of the Return-Beam Vidicon (RBV) television system and the Multispectral Scanner (MSS) on board the ERTS satellite. The images telemetered from these two imaging sensors will be converted to film and will constitute the basic data for most ERTS experiments and earth resources investigations. The overall system requires geometric and radiometric calibration, specialized image processing, and ground control points for cartographic reference. Development of calibration data for the RBV is discussed, together with research on the geometrical distortions of high-resolution television systems. T.M.

A72-10453 Data annotation in earth resources surveys. R. D. Hopkin and L. D. Van Valkenburgh (Fairchild Industries, Inc., Space and Electronics Div., Germantown, Md.). In: American Society of Photogrammetry, Fall Convention, Symposium on Computational Photogrammetry, San Francisco, Calif., September 7-11, 1971, Proceedings. Falls Church, Va., American Society of Photogrammetry, 1971, p. 265-284.

Analysis of the pictorial records obtained from remote sensing of earth resources will require recording and correlation of much supplemental data. The volume of these records and data and the diversity of supplemental data sources pose a complex problem in data management. An effective system will be computer oriented for both data correlation and annotation of pictorial records, and for efficient retrieval of archival records. The requirement for extensive duplication and dissemination of pictorial records dictates that both alphanumeric and coded data be annotated on master records. Current military technology in data recording and film annotation may be integrated into a data handling system compatible with the diverse characteristics of aircraft and manned or unmanned satellite surveys. (Author)

A72-10454 Implementation of digital techniques for correcting high resolution images. H. Markarian, R. Bernstein, D. G. Ferneyhough, L. E. Gregg, and F. S. Sharp (IBM Corp., Gaithersburg, Md.). In: American Society of Photogrammetry, Fall Convention, Symposium on Computational Photogrammetry, San Francisco, Calif., September 7-11, 1971, Proceedings. Falls Church, Va., American Society of Photogrammetry, 1971, p. 285-304. 13 refs.

An efficient, high-speed algorithm for applying geometric corrections to high resolution images has been developed and implemented as a digital computer program. This algorithm was applied to two images representative of those to be generated by the return beam vidicon which will be used during the Earth Resources Technology Satellite Program. Processing of each image required 80 seconds of CPU time and 450 kilobytes of memory on an IBM System/360 Model 65. In a companion experiment using the same two images, a simple 'shadow casting' technique for detecting and locating reseau marks in the RBV data was found to be quite adequate for support of the geometric correction process. (Author)

A72-10457 Image interpretation keys to support analysis of SLAR imagery. J. C. Coiner (Center for Research, Inc., Lawrence, Kan.) and S. A. Morain (Center for Research, Inc.; Kansas University, Lawrence, Kan.). In: American Society of Photogrammetry, Fall Convention, Symposium on Computational Photogram-

metry, San Francisco, Calif., September 7-11, 1971, Proceedings. Falls Church, Va., American Society of Photogrammetry, 1971, p. 393-412. 21 refs.

Possible uses of dichotomous keys as aids in the analysis of side-looking airborne radar imagery are examined, with arguments directed at future remote sensing programs in agriculture and natural vegetation. For agriculture, keys are designed to determine crop types or conditions. For natural vegetation, the keys attempt to define major plant communities and ecological situations. It is concluded that properly prepared keys increase the validity of interpretations and the range of image utility. T.M.

A72-10458 Precision processing of ERTS imagery. V. Kratky (National Research Council, Ottawa, Canada). In: American Society of Photogrammetry, Fall Convention, Symposium on Computational Photogrammetry, San Francisco, Calif., September 7-11, 1971, Proceedings. Falls Church, Va., American Society of Photogrammetry, 1971, p. 481-514. 7 refs.

Imagery received from the Multispectral Scanning system on board the ERTS satellite will be considerably distorted as a consequence of several factors. The character of the distortion depends partly on the geometrical properties of the imaging system and on the changes which affect the attitude of the sensor during the flight. The geometry of the system is analyzed, and an appropriate analytical solution is proposed that can provide correction parameters necessary for precision processing of the images. The format of the solution adopted for the Canadian ERTS program is outlined. T.M.

A72-11799 # Evaluation of space and high altitude imagery for the Department of the Interior. C. D. Sapp (Raytheon Co., Alexandria, Va.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 435-451. 8 refs.

Ground observations of selected features interpreted from simulated Earth Resources Observations Systems (EROS) imagery, high-altitude aircraft, and Apollo 9 multispectral photography were made over areas in eastern Arizona. This work was supplemented to an earlier effort in May 1970, in which Earth Resources Technology Systems (ERTS-A) imagery was simulated, enhanced, and detailed interpretations of the space and high-altitude imagery were performed without the aid of collateral data. It is shown that ERTS-A imagery will be useful for many Interior tasks and functions requiring areal information, such as interpretation of geologic structures. Apollo 9 and high-altitude aircraft photography also provides useful information for a number of Interior activities. Certain additive color experiments performed in order to create false color images show promise and the demonstrated techniques have important advantages over color infrared photography. O.H.

A72-11801 # Quantitative image enhancement of photographic and non-photographic data for earth resources. J. Bodechtel (München, Universität, Munich, West Germany) and G. Kritikos (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Satellitenelektronik, Oberpfaffenhofen, West Germany). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 469-486. Research supported by the Deutsche Forschungsgemeinschaft.

Multispectral satellite- and air-photographs and imagery of different electromagnetic spectral ranges were analyzed by an electronic enhancement computer, for earth science problems. Photographs and imagery were systematically studied with different techniques for automatic interpretations, in order to enhance relief and to map normal and spread equidensities of linear and areal elements. (Author)

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A72-11811 # On a procedure of coding the optical spectral reflectance of natural formations. K. Ia. Kondrat'ev, O. B. Vasil'ev, and Z. F. Mironova (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 647-661. 15 refs.

Description of a procedure for selecting the optimal method of coding natural formation spectra. The procedure is shown to make it possible to select a method that is optimal not only in that it permits to establish a single-valued relationship between the spectral code and the character of the reflecting surface for the benefit of remote-sensing aerospace investigations of the earth surface, but also in that it allows a speedy and effective solution of the inverse problem in determining the type of natural formations from their optical spectral reflectance. The principle of coding described permits a comprehensive classification of reflecting surfaces according to their type by means of techniques easily processed with the aid of electronic digital computers. M.V.E.

A72-11824 * # Uses of earth resources data in the NASA/MSC Earth Resources Research Data Facility. E. O. Zeitler and R. D. Bratton (NASA, Manned Spacecraft Center, Houston, Tex.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 2. Ann Arbor, University of Michigan, 1971, p. 925-936.

The operation of the Earth Resources Research Data Facility (ERRDF) in Clear Lake City, Texas, which contains both aircraft and spacecraft gathered information on remote sensing of earth resources, including geology, geography, agriculture, forestry, hydrology, and oceanography, is described in detail. Possible uses of ERRDF data for further studies and applications are discussed. O.H.

A72-11834 * # Information content of simulated space photographs as a function of various levels of image resolution. D. T. Lauer and R. R. Thaman (California, University, Berkeley, Calif.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 2. Ann Arbor, University of Michigan, 1971, p. 1191-1203. NASA-supported research. NASA Order R-03-038-002.

The results of research are reported on the information content in simulated space photographs derivable as a function of various levels of image resolution. Whenever certain resource features could not be consistently identified on simulated low-resolution imagery, attempts were made to define the required level of image resolution that would allow a skilled interpreter to discriminate one feature from another. The results of this research, conducted within a chaparral-hardwood-grassland environment in California, indicate that simulated ERTS data contain sufficient information to allow an interpreter to discriminate between woody vegetation, grassland, and water bodies. However, if more detailed information is desired, the imagery must have a ground resolution of at least 50 ft, showing shape, size, texture, and shadow characteristics within each vegetation type. Spaceborne data, therefore, often will have to be supplemented by higher resolution aircraft imagery, depending on the types of resource information being sought. M.V.E.

A72-11841 * # Preprocessing techniques to reduce atmospheric and sensor variability in multispectral scanner data. R. B. Crane (Michigan, University, Ann Arbor, Mich.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 2. Ann Arbor, University of Michigan, 1971, p. 1345-1355. 7 refs. Contract No. NAS9-9784.

Multispectral scanner data are potentially useful in a variety of remote sensing applications. Large-area surveys of earth resources carried out by automated recognition processing of these data are particularly important. However, the practical realization of such surveys is limited by a variability in the scanner signals that results in

improper recognition of the data. This paper discusses ways by which some of this variability can be removed from the data by preprocessing with resultant improvements in recognition results.

(Author)

A72-11842 * # Computer identification of ground pattern from aerial photographs. A. J. Richardson, R. J. Torline, and W. A. Allen (U.S. Department of Agriculture, Soil and Water Conservation Research Div., Weslaco, Tex.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 2. Ann Arbor, University of Michigan, 1971, p. 1357-1376. NASA-supported research.

Two statistical models are compared in the classification of crops recorded on color aerial photographs. A theory of error ellipses is applied to the pattern recognition problem. An elliptical boundary condition classification model (EBC), useful for recognition of candidate patterns, evolves out of error ellipse theory. The EBC model is compared with the minimum distance to the mean (MDM) classification model in terms of pattern recognition ability. The pattern recognition results of both models are interpreted graphically using scatter diagrams to represent measurement space. Measurement space, for this report, is determined by optical density measurements collected from Kodak Ektachrome Infrared Aero Film 8443 (EIR). The EBC model is shown to be a significant improvement over the MDM model. (Author)

A72-11845 # Correlation studies with ground truth and multispectral data - Effect of size of training field. C. B. Roth and M. F. Baumgardner (Purdue University, Lafayette, Ind.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 2. Ann Arbor, University of Michigan, 1971, p. 1403-1414. 7 refs.

The effect of the size of training sets of multispectral scanner data on the correlation with soil organic matter content as determined by laboratory analysis is assessed. It is shown that the size of the training set for computer implemented analysis of multispectral data has an appreciable effect on the correlation between soil reflectance and organic matter content. The selection and number of channels also has a profound influence on this correlation. V.P.

A72-11847 * # Digital correction of geometric and radiometric errors in ERTS data. R. Bakis, M. A. Wesley, and P. M. Will (IBM Thomas J. Watson Research Center, Yorktown Heights, N.Y.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 2. Ann Arbor, University of Michigan, 1971, p. 1427-1436. 13 refs. Contract No. NAS5-11260.

The sensor systems of the ERTS-A satellite are discussed and sources of geometric and radiometric errors in the received images are identified. Digital algorithms are presented for detection of resample and ground control points, for rapid implementation of geometric corrections, and for radiometric correction of errors caused by shading, image motion, modulation transfer function, and quantum and systematic noise. (Author)

A72-11873 # Spectral parameters affecting automated image interpretation using Bayesian probability techniques. W. G. Brooner (California, University, Riverside, Calif.), R. M. Haralick (Kansas, University, Lawrence, Kan.), and I. Dinstein (Center for Research, Inc., Lawrence, Kan.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 1929-1949. 10 refs. Contract No. N00014-69-A-0200-5001; Grant No. DAAK02-68-C-0089. Project THEMIS.

Description of results of the implementation of a Bayesian

Decision Rule to the identification of remotely sensed data consisting of very high altitude 35mm IR Ektachrome and black and white, multiband photography flown over California in 1969. Several approaches to the identification of a variety of known agricultural land-use categories occurring in the study region were taken. Analysis of the data suggests the following conclusions: (1) approximately 70% correct identification accuracy can be achieved; (2) there is no general advantage to any of the particular quantizing and normalizing procedures tested; and (3) the spectral texture effects which occur at an extremely small image scale can be used to increase the accuracy of land-use identification. M.M.

A72-11875 * # Variables in automatic classification over extended remote sensing test sites. R. M. Hoffer and F. E. Goodrick (Purdue University, Lafayette, Ind.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 1967-1981. 7 refs. Grant No. NGL-15-005-112.

Four major causes of variation in response of multispectral scanner data were examined utilizing data from two large test sites. In one case, data throughout a 70-mile flightline was automatically classified with a high degree of accuracy (98%), utilizing training samples from a single small segment of the data. In the second case, spectral data for wheat and other cover types were calibrated and utilized to train the computer, resulting in data up to 90 miles away being classified with an acceptable degree of accuracy (91%), although significant changes in solar illumination and ground cover conditions existed. (Author)

A72-12081 * # Geomagnetic survey by the polar-orbiting Geophysical Observatories. J. C. Cain and R. A. Langel (NASA, Goddard Space Flight Center, Greenbelt, Md.). In: World magnetic survey 1957-1969. Paris, International Union of Geodesy and Geophysics, 1971, p. 65-75. 14 refs.

Summary of reduced data from the polar Orbiting Geophysical Observatories OGO 2 and 4, spanning the time period from Oct. 14, 1965 to the end of 1967. A brief discussion of the accuracy of the observations is followed by a description of the data extent. It is shown that the quantity of data acquired by the OGO magnetometers far exceeds the total for all other magnetic survey sources. Data acquisition for only about a two-week interval gives virtually complete global coverage. Procedures and considerations underlying the data analysis performed are discussed. Suggestions for further work are presented. M.V.E.

A72-12082 # The survey with Cosmos-49. N. P. Benkova and Sh. Sh. Dolginov (Akademiia Nauk SSSR, Institut Zemnogo Magnetizma, Ionosfery i Rasprostraneniia Radiovoln, Moscow, USSR). In: World magnetic survey 1957-1969. Paris, International Union of Geodesy and Geophysics, 1971, p. 75-78. 11 refs.

Summary of the main features of the geomagnetic survey performed by means of the Cosmos-49 satellite as part of the international World Magnetic Survey program. The satellite was launched into an orbit with a 49 deg inclination, 260 km perigee, and 490 km apogee. Measurements were made each 32.76 seconds during a magnetically quiet period from Oct. 24 to Nov. 6, 1964. A memory unit permitted sampling over a relatively large number of satellite positions, whose projections covered about 75% of the earth's surface. The accuracy of the observations and some of the procedures followed in data analyses are briefly discussed, along with a few of the results obtained. M.V.E.

A72-12083 # Satellite 1964 83C. A. J. Zmuda (Johns Hopkins University, Silver Spring, Md.). In: World magnetic survey 1957-1969. Paris, International Union of Geodesy and Geophysics, 1971, p. 78-81. 7 refs.

Summary of the distinctive flight, equipment, and performance characteristics of the satellite 1964 83C, and review of some of the

reduced data obtained. The satellite telemetered a total of 350,000 usable data points to a network of 16 ground stations. Power and voltage limitations confined the data periods inside the intervals Dec. 13-31, 1964, and Apr. 10 to June 26, 1965. Observations exist for four storms, a mixture of smaller disturbances, and undisturbed conditions. Isodynamic lines at a geocentric distance of 7450 km with intensity values in units of 1000 gammas are presented on a world map showing the locations of ground stations. The Brazilian magnetic anomaly is briefly discussed, along with storm-time field characteristics. M.V.E.

A72-12172 # Reliability of the process of decoding aerial photos (Nadezhnost' protsessa deshifirovaniia aerosnimkov). L. E. Smirnov. *Geodeziia i Aerofoto'semka*, no. 4, 1970, p. 79-84. In Russian.

Development of quantitative criteria of reliability of aerial photo decoding. The dependence of the decoding reliability on the observation time is considered, and an analysis is made of the main causes of unreliability of the work of decoders. The results of a study of the reliability of the work of experienced and inexperienced decoders using various combinations of photographic properties and aerial photo scales and various decoding techniques are presented. A.B.K.

A72-12200 Ground data collection and use. A. S. Benson, W. C. Draeger, and L. R. Pettinger (California, University, Berkeley, Calif.). *Photogrammetric Engineering*, vol. 37, Nov. 1971, p. 1159-1166.

Discussion of space and high-altitude aerial photography used in an agricultural resources survey in Arizona as part of a NASA research project. Special attention is given to the problems encountered when extensive sequential agricultural ground data are collected. Details are given on the selection of data amount and observation time, and on suitable methods for data collecting, handling and compiling in a useful form. Procedures are described for ground data processing in a survey evaluation process. V.Z.

A72-12381 Earth resources data users. W. A. Radlinski (U.S. Geological Survey, Washington, D.C.). In: EASCON '71: Electronics and Aerospace Systems Convention, Washington, D.C., October 6-8, 1971, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 78-82.

An estimate is developed of the general character and size of the community of earth resources data users, including both domestic and foreign organizations and individuals, that will be using orbital earth-resources data after the launch of the first Earth Resources Technology Satellite, ERTS-A, in the spring of 1972. It is expected that these users may require more than 20 million photographic prints per year. A data center at Sioux Falls, South Dakota, is being designed to be the central repository for data processing, interpretation, and dissemination of remote-sensor data from aircraft and satellites for resource and environmental surveys. M.V.E.

A72-21206 Program of data location and collection (Programme de localisation et de collecte de données). D. Thieriet (Centre National d'Etudes Spatiales, Brétigny-sur-Orge, Essonne, France). *L'Onde Electrique*, vol. 52, Jan. 1972, p. 33-38. In French.

Description of the Géole satellite program designed to establish a geodetic survey system capable of accuracies of the order of 2 m for distances and 2 mm/sec for radial velocities (Doppler-measured). The problems posed by the establishment of such a system are reviewed. Special attention is given to the propagation and selection of frequencies, antenna problems, choice of Doppler and distance-measuring systems, analysis of various instrument errors including noise, instabilities, drift, and transit time. Various possible applications of the Géole system are briefly considered. M.V.E.

A72-23276 Internationale Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Parts 1 &

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2 (Internationale Gesellschaft für Photogrammetrie, Internationale Symposium für Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Berichte. Parts 1 & 2). Symposium sponsored by the Gesellschaft für Photogrammetrie in der Kammer der Technik. Leipzig, Landwirtschaftsausstellung der DDR (Internationales Archiv für Photogrammetrie, Volume 18), 1971. Pt. 1, 652 p.; pt. 2, 482 p. In German, English, and French.

The papers deal with the individual elements of such broad concepts as the analysis of landscapes on the basis of aerial photographs; the photointerpretation of vegetation; the photointerpretation of natural resources from satellite photographs; the methodological, psychological, and physiological factors in photointerpretation; remote sensing and its applications; and the automation of photointerpretation.

V.P.

A72-23277 # Aerial photography and the study of the natural environment (Luftbild und Studium der natürlichen Umwelt). V. B. Komarov (Laboratorium für Aeromethoden, Leningrad, USSR). In: Internationale Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 1. (A72-23276 09-13) Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 9-24. In German.

Various aspects of the application of aerial photography to the study of the natural environment and natural resources are examined. Particular attention is given to the specific features of the information contained in aerial photographs and to methods of interpreting the latter.

V.P.

A72-23292 # Advances and possibilities of photo interpretation for the branches of science concerned with the study of the earth, giving particular attention to satellite photos (Fortschritte und Möglichkeiten der Photointerpretation für die Erdwissenschaften unter besonderer Berücksichtigung von Satellitenphotos). J. Bodechtel (München, Universität, Munich, West Germany). In: Internationale Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 1. Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 385-414. 41 refs. In German.

The status of the interpretation of photos for earth resource studies and other geologic applications has advanced considerably within the last decade. New methods of photography were developed together with films for many ranges of the EM spectrum. Quantitative approaches on photogrammetric basis become increasingly important. Automation and the employment of digital methods provide the possibility for a complete evaluation of the pictures obtained. A number of pictures obtained with the aid of satellites are presented, and questions of their evaluation are discussed.

G.R.

A72-23300 # 'Internal' and 'integral' photointerpretation (Interne und integrale Photointerpretation). H. Schmidt-Falkenberg (Institut für angewandte Geodäsie, Frankfurt am Main, West Germany). In: Internationale Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 2.

Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 623-628. 16 refs. In German.

An interpretation which is conducted to obtain information concerning a certain field is generally most productive if it is carried out by an expert of this field. An interpretation method which does not make use of the services of other experts of the same field is defined as 'internal' interpretation. 'Integral' interpretation, on the other hand, makes use of the statements of a number of experts in the field of interest in the interpretation of aerial photos. Volume and reliability of information obtained by an 'integral' interpretation are discussed.

G.R.

A72-23303 # Terrain evaluation by remote sensing. W. Mintzer (Ohio State University, Columbus, Ohio). In: Internationale Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 2. Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 657-678. 61 refs.

The images which are best suited for a given task are considered on the basis of the experience obtained in a number of terrain investigations. The film types for a specific terrain investigation are discussed, giving attention to a comparison of the color sensitivities of the films. The IR portion of the spectrum has a potential for revealing natural features on IR scanned imagery. Types of terrain considered include landslide-susceptible terrain, soft subsoil terrain, coastal regions, stream valleys, terraces, and upland.

G.R.

A72-23306 # The employment of quantitatively determined characteristics of the photographic texture of black-and-white aerial photographs for the identification of a number of objects (Die Verwendung quantitativ erfasster Merkmale der photographischen Textur von Schwarz-Weiss-Luftbildern für die Identifizierung einiger Objekte). A. Akca (Freiburg, Universität, Freiburg im Breisgau, West Germany). In: Internationale Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 2.

Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 737-751. 20 refs. In German.

Photogrammetric textures of different objects were quantified by measurements of photographic density with a microdensitometer in order to differentiate and identify the land use patterns with the aid of discriminatory analysis. The objects considered include forest stands of Norway spruce and European beech of various ages, forest cultures, fields, water areas, and traffic areas. The evaluation of the microdensitometer measurements is discussed together with aspects of the combination of the three statistical parameters.

G.R.

A72-23314 # The use of aerial photographs interpretation in terrain evaluation for engineering purposes. K. Grant (Commonwealth Scientific and Industrial Research Organization, Div. of Soil Mechanics, Mount Waverley, Victoria, Australia). In: Internationale Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 2.

Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 949-974. 7 refs.

Discussion approaches to aerial photograph interpretation for terrain evaluation and classification in terms of physiography, geology, soil and vegetation, for engineering purposes within the scope of the P.U.C.E. (pattern-unit-component-evaluation) program. Numerous examples from various diverse areas of Australia are discussed to show how specific situations could be treated to overcome interpretation difficulties which may arise in geology, soil and vegetation evaluations. Stereopairs of black and white photographs are included to illustrate each example of interpretation.

V.Z.

A72-28525 # Descriptive representations of remotely sensed image data. O. Firschein and M. A. Fischler (Lockheed Research Laboratories, Palo Alto, Calif.). *Institute of Electrical and Electronics Engineers, Annual Symposium, Anaheim, Calif., Oct. 25-27, 1971, Paper.* 34 p. 16 refs. Research supported by the Lockheed Independent Research Program; Contract No. N00014-70-C-0239.

Consideration of natural language descriptions of image data, i.e., words, phrases, or sentences which attempt to capture aspects of the content or 'meaning' of an image. Such an investigation has application to artificial intelligence, linguistic analysis, and retrieval. For the latter topic, the concept of an 'encyclopedic entry' for an image is considered, a representation complete enough to be used in place of the image to answer questions concerning the image. Canonical forms for descriptions and method of combining forms to obtain composite descriptions are discussed, using descriptions obtained from recent earth resources documents.

F.R.L.

A72-31242 # Data analysis program for the Earth Resources Technology Satellite imagery of Israel. J. Otterman (Tel Aviv University, Tel Aviv, Israel). In: Space activity in the field of ecology and earth resources; International Convention on Space, 12th, Rome, Italy, March 23-25, 1972, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1972, p. 267, 269-274.

It is expected that the multispectral TV camera system and the multispectral scanner of the Earth Resources Technology Satellite will be operated over Israel and the imagery provided to the Tel-Aviv University for analysis. The analysis, in most cases jointly with the Institutions that can be regarded as direct users of the data, will provide valuable information for Israeli hydrology, agriculture, forestry, and arid regions vegetation, and oceanography. The method of analysis will be by conventional photo-interpretation techniques in the early stages of the work, but with a planned shift to the multispectral radiometric analysis by computer. The radiometric analysis will be carried out through search for areas with the same spectral characteristics as the known ground sites which are located in the same image. (Author)

A72-31243 # Study of the possibility of use of the Intelsat system for the retransmission of data received by earth resources satellites (Studio della possibilita' di impiego del sistema Intelsat per la ritrasmissione dei dati ricevuti dai satelliti per risorse terrestri). G. Quaglione and E. Vitali (Telespazio S.p.A., Rome, Italy). In: Space activity in the field of ecology and earth resources; International Convention on Space, 12th, Rome, Italy, March 23-25, 1972, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1972, p. 275, 277-288. 5 refs. In Italian.

Description and technical and economical evaluation of system configurations for the transfer of data from earth resources satellites to processing centers on the ground. The possibility of use of geostationary Intelsat satellite networks is considered in detail.

B.B.M.

A72-31246 # Low cost ERTS receiving station. H. A. Grant (Saskatchewan, University, Saskatoon, Saskatchewan, Canada) and R. E. Barrington (Department of Communications, Communications Research Centre, Ottawa, Canada). In: Space activity in the field of ecology and earth resources; International Convention on Space, 12th, Rome, Italy, March 23-25, 1972, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1972, p. 331, 333-342.

Study of the problem of optimization of an Earth Resources Technology Satellite (ERTS) station to be constructed with the objective to track the satellite and to receive and record the image data from the satellite systems. It is concluded that by optimizing the system for local requirements and conditions, a substantially lower cost of the station is possible. The equipment for a basic station with a 7-m antenna, without redundancy, computer or video tape recorder could be purchased for under \$550,000. O.H.

A72-31248 # Weather satellite pictures for earth resources studies. K. Itten, R. Gfeller, and H. Haefner (Zürich, Universität, Zurich, Switzerland). In: Space activity in the field of ecology and earth resources; International Convention on Space, 12th, Rome, Italy, March 23-25, 1972, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1972, p. 363, 365-375. 11 refs.

The capabilities and limitations of existing ESSA- and NIMBUS-imagery for earth resources studies are demonstrated, and some methodological and technical procedures are discussed as a preliminary experiment to the forthcoming ERTS-project. The problem of 'geographical interpretability' for Europe and North Africa is first dealt with, followed by a discussion of some techniques and instruments to facilitate and improve the interpretations demonstrated by means of selected regional and thematical examples. O.H.

A72-31253 # Contribution to the unified processing of remote observation techniques (Contributo alla trattazione unificata delle tecniche di teleosservazione). B. Ratti (Telespazio S.p.A., Rome, Italy). In: Space activity in the field of ecology and earth resources; International Convention on Space, 12th, Rome, Italy, March 23-25, 1972, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1972, p. 465, 467-476. 7 refs. In Italian.

The problem of the remote observation of earth resources is treated from a system point of view. It is pointed out that for the information system, a unitary and interdisciplinary processing is possible. In conclusion, the necessity for Italy to have available a station and a center for preprocessing spatial platform data is noted. B.B.M.

A72-31807 The global photography of the earth and the possibilities of data interpretation. B. V. Vinogradov and K. Ia. Kondrat'ev (Akademii Nauk SSSR, Moscow, USSR). In: International Astronautical Congress, 20th, Mar del Plata, Argentina, October 5-10, 1969, Proceedings. Oxford, Pergamon Press, Ltd.; Warsaw, Panstwowe Wydawnictwo Naukowe, 1972, p. 139-152. 17 refs.

The global photographs represent super-small-scale space photographs or TV pictures of the earth as obtained from the high-orbital satellites Molniya, ATS, the automatic stations Zond and the spacecrafts Apollo. Feasibility of their usage with the purpose of obtaining both global and local information on the natural complexes of the planetary geographical zones and landscape types is discussed. (Author)

A72-34401 Two Dimensional Digital Signal Processing Conference, University of Missouri, Columbia, Mo., October 6-8, 1971, Proceedings. Conference sponsored by the University of Missouri and Atlantic Richfield Co. Edited by C. F. George (Atlantic Richfield Co., Dallas, Tex.) and E. L. Hall (Missouri, University, Columbia, Mo.). New York, Institute of Electrical and Electronics Engineers, Inc., 1972. 347 p. Members, \$12.50; nonmembers, \$17.50.

Papers on two-dimensional digital signal processing in computer pictorial data applications are covered. The topics include two-dimensional Wiener filtering, digital image enhancement, recursive image estimations, recognition networks, interactive imagery analysis, photo reconnaissance, texture measurements, landmark recording and cloud motion tracking.

V.Z.

A72-34409 # Design requirements for texture measurements. G. D. Swanlund (Honeywell, Inc., Systems and Research Div., Roseville, Minn.). In: Two Dimensional Digital Signal Processing Conference, Columbia, Mo., October 6-8, 1971, Proceedings.

New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 8-3-1 to 8-3-9. 14 refs.

Discussion of data processing rate requirements for an earth resources data management system to determine the possibility of effective texture measurements by automatic photo interpretation devices with the application of analog and digital techniques. The advantages and disadvantages of using a fixed area for computations are evaluated, noting the convenience of fixed area applications, notwithstanding the compromise involved. Specifications are given for an optical correlator, a coherent light Fourier analyzer and a flying-spot scanner to be used in measurements with analog implementation. The fast Fourier transform algorithm and the fast Walsh transform are considered as the instruments of digital implementations. The processing rates attainable by this automatic photo interpretation technique are rated as practical in selected applications and for selected portions of the U.S. V.Z.

A72-36494 # A learning system for terrain recognition. J. M. Idelsohn (Bendix Information Sciences Laboratory, Southfield, Mich.). *Bendix Technical Journal*, vol. 5, Spring 1972, p. 33-38.

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Contract No. F33615-68-C-1082.

Description of a pattern-recognition system which is capable of automatically classifying terrain type from aerial photography. Conventional panchromatic single-frame aerial photographs of the earth are converted by a flying-spot scanner to a time-varying video signal suitable for processing. Processing consists of a series of analog and digital operations that lead to a terrain classification based on spatial texture in the region of the input point. A learning strategy enables the system to refine its processing operations and thus to improve its classification accuracy with time. Test results obtained to date are summarized. (Author)

A72-36496 * # The image-processing system for the Earth Resources Technology Satellite. R. H. Johnson (Bendix Corp., Aerospace Systems Div., Ann Arbor, Mich.). *Bendix Technical Journal*, vol. 5, Spring 1972, p. 46-51. NASA-supported research.

Description of the image-processing system for the Earth Resources Technology Satellite (ERTS), which will process videotape recordings received from the satellite into imagery and digitized video data suitable for earth-resource study and analysis. The system is made up of three subsystems. The bulk processor produces 70-mm images and digitized records, corrected for systematic geometric and radiometric errors as well as for sensor-calibration and other errors. The precision processor modifies the bulk images to significantly increase geometric precision. The special processor transfers either bulk or precision data to computer-compatible tape. (Author)

A72-36497 * # The precision-processing subsystem for the Earth Resources Technology Satellite. W. E. Chapelle, J. E. Bybee, and G. M. Bedross (Bendix Information Sciences Laboratory, Southfield, Mich.). *Bendix Technical Journal*, vol. 5, Spring 1972, p. 52-60. NASA-supported research.

Description of the precision processor, a subsystem in the image-processing system for the Earth Resources Technology Satellite (ERTS). This processor is a special-purpose image-measurement and printing system, designed to process user-selected bulk images to produce 1:1,000,000-scale film outputs and digital image data, presented in a Universal-Transverse-Mercator (UTM) projection. The system will remove geometric and radiometric errors introduced by the ERTS multispectral sensors and by the bulk-processor electron-beam recorder. The geometric transformations required for each input scene are determined by resection computations based on reseau measurements and image comparisons with a special ground-control base contained within the system; the images are then printed and digitized by electronic image-transfer techniques. (Author)

A72-38770 # Complex analysis of satellite data for electromagnetic emission measurements in the radio, infrared and optical wavelength ranges (Kompleksnyi analiz rezul'tatov izmerenii so sputnikov elektromagnitnogo izlucheniia v radio, infrakrasnom i opticheskom diapazonakh). E. P. Dombkovskaia (Glavnoe Upravlenie Gidrometeorologicheskoi Sluzhby SSSR, Gidrometeorologicheskii Nauchno-Issledovatel'skii Tsentr, Moscow, USSR) and L. M. Mitnik (Akademiia Nauk SSSR, Institut Radiotekhniki i Elektroniki, Moscow, USSR). *Meteorologiya i Gidrologiya*, June 1972, p. 23-31. 9 refs. In Russian.

Synoptic conditions over the Atlantic and Pacific Oceans are analyzed by using TV, IR, actinometric and microwave data from Cosmos 226 and 243, and ESSA 6 and 7. The advantages of a complex analysis of these data for obtaining additional information on atmospheric processes are noted. V.Z.

A72-43025 * Suitability of the normal density assumption for processing multispectral scanner data. R. B. Crane, W. A. Malila, and W. Richardson (Michigan, University, Ann Arbor, Mich.). *IEEE Transactions on Geoscience Electronics*, vol. GE-10, Oct. 1972, p. 158-165. 9 refs. Contract No. NAS9-9784.

Assessment of the normal likelihood function as an aid in the processing of multispectral scanner data. The experimental results of described tests indicate that the use of the normal likelihood

function is justified for recognition processing of multispectral data. M.V.E.

A73-10275 # Colour separation and electronic analysis of Gemini V and Apollo spacecraft photography. G. R. Cochrane (Auckland, University, Auckland, New Zealand). *British Interplanetary Society, Journal*, vol. 25, Nov. 1972, p. 655-668. 8 refs.

Three techniques for analyzing spacecraft photographs and the preliminary results from laboratory methods and field checking of boundaries are discussed. The techniques are the use of color prints, boundary discrimination by the use of color separations, and analysis of information by electronic color combining techniques. Primarily all of these techniques have been aimed at the problem of recognizing boundaries on photographs taken from spacecraft. A second aspect of the problem of the potential use of spacecraft photography for thematic mapping is determining what the boundaries define. The usefulness of the information depends on whether the photograph is orthogonal or oblique, the clarity and sharpness of boundaries, absence of cloud cover obscuring information, color fidelity, and blueness. F.R.L.

A73-11451 Information processing 71; Proceedings of the Congress, Ljubljana, Yugoslavia, August 23-28, 1971. Volume 1 - Foundation and Systems. Volume 2 - Applications. Congress sponsored by the International Federation for Information Processing. Edited by C. V. Freiman (IBM Thomas J. Watson Research Center, Yorktown Heights, N.Y.). Amsterdam, North-Holland Publishing Co., 1972. Vol. 1, 790 p.; vol. 2, 857 p. Price of two volumes, \$150.

Recent developments in the field of computerized information processing are covered in papers dealing with mathematical foundations, computer software and hardware trends, and computerized data processing applications in management, engineering, mathematics, sciences, humanities, and education. Topics considered include pattern recognition, artificial intelligence, mathematical models, aspects of programming, computer architecture, voice input hardware, communications, managerial models, computer aided design, engineering data acquisition, experiment planning, numerical analysis procedures, and handling of biomedical data.

Individual items are announced in this issue. T.M.

A73-11457 * Digital image processing for the earth resources technology satellite data. P. M. Will, R. Bakis, and M. A. Wesley (IBM Thomas J. Watson Research Center, Yorktown Heights, N.Y.). In: Information processing 71; Proceedings of the Congress, Ljubljana, Yugoslavia, August 23-28, 1971. Volume 2.

Amsterdam, North-Holland Publishing Co., 1972, p. 1138-1143. 11 refs. Contract No. NAS5-11260.

This paper discusses the problems of digital processing of the large volumes of multispectral image data that are expected to be received from the ERTS program. Correction of geometric and radiometric distortions are discussed and a byte oriented implementation is proposed. CPU timing estimates are given for a System/360 Model 67, and show that a processing throughput of 1000 image sets per week is feasible. (Author)

A73-11476 Digital image-processing activities in remote sensing for earth resources. G. Nagy (Nebraska, University, Lincoln, Neb.). *IEEE, Proceedings*, vol. 60, Oct. 1972, p. 1177-1200. 231 refs.

A73-11478 A comparison of analog and digital techniques for pattern recognition. K. Preston, Jr. (Perkin-Elmer Corp., Norwalk, Conn.). *IEEE, Proceedings*, vol. 60, Oct. 1972, p. 1216-1231. 29 refs.

Electronic, acoustical, and optical analog computers for use in pattern recognition are discussed and their performance compared with that of both general-purpose and special-purpose digital computers. It is shown that the analog computer offers workers using low-precision high-speed one-dimensional or two-dimensional linear discriminant analysis a significant advantage in hardware performance (equivalent bits per second per dollar) over the digital computer in certain limited but important areas. These areas include

fingerprint identification, word recognition, chromosome spread detection, earth-resources and land-use analysis, and broad-band radar signal processing. A trend analysis indicates that the advantages of analog computation will probably be overcome in the next few decades by advances in digital-computer hardware. (Author)

A73-14485 # Pattern recognition in remote sensing. K. S. Fu (Purdue University, Lafayette, Ind.). In: Annual Allerton Conference on Circuit and System Theory, 9th, Monticello, Ill., October 6-8, 1971, Proceedings. Urbana, University of Illinois, 1972, p. 951-974. 38 refs. NSF Grant No. GK-18225.

This report discusses the application of pattern recognition techniques to the problem of classifying remotely sensed multispectral data. Problems treated include (1) parametric and nonparametric pattern classification and (2) feature extraction and selection. The implementation of these techniques are also discussed. Experimental results from the classifications of agricultural crops are used to demonstrate the applications. (Author)

A73-15384 Canadian E.R.T.S. data handling system. W. M. Strome (Department of Energy, Mines and Resources, Canada Centre for Remote Sensing, Ottawa, Canada). In: NTC '72; National Telecommunications Conference, Houston, Tex., December 4-6, 1972, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 7D-1 to 7D-6.

A computerized data processing facility in Ottawa is used to generate latent photographic images from magnetic-tape recordings of ERTS return-beam vidicon (RBV) and multispectral scanner (MSS) data received at the Prince Albert Satellite Station. The Ottawa facility features a dual-computer arrangement providing a general-purpose time-sharing system and an image processing system. Emphasis is placed on signal calibration, compensation, deskewing, and decoding functions involved in playback of the RBV and MSS data to drive electron-beam and laser-beam image recording devices. T.M.

A73-15404 Information processing by space systems for meteorology and earth resources. L. Norwood (Hughes Aircraft Co., El Segundo, Calif.). In: NTC '72; National Telecommunications Conference, Houston, Tex., December 4-6, 1972, Record. New York, Institute of Electrical and Electronics

Engineers, Inc., 1972, p. 14E-1 to 14E-5. 31 refs.

Demonstration of the appropriateness of an information transfer satellite system (ITSS) for the timely collection and relay of earth-resource and meteorological information data acquired in situ by sensors placed on the 14,000 remote sensing platforms (RSP) presently deployed on the land and sea surface and at various levels of the atmosphere. This RSP number is expected to grow to 26,000 by 1975. In order to evaluate the feasibility and potential benefits of the ITSS, pertinent parameters for 1975 are postulated. Based upon existing systems and upon projections of present plans, the number of RSP's and their message traffic are estimated. M.V.E.

A73-15413 * Digital image registration by correlation techniques. D. J. Popp, D. S. McCormack, and G. M. Lee (McDonnell Douglas Corp., St. Louis, Mo.). In: NTC '72; National Telecommunications Conference, Houston, Tex., December 4-6, 1972, Record. New York, Institute of Electrical and Electronics

Engineers, Inc., 1972, p. 24D-1 to 24D-5. Contract No. NAS5-21662.

This study considers the translation problem associated with digital image registration and develops a means for comparing commonly used correlation techniques. Using suitably defined constraints, an optimum and four suboptimum registration techniques are defined and evaluated. A computational comparison is made and Gaussian image statistics are used to compare the selected techniques in terms of radial position location error. (Author)

A73-15772 Automatic terrain classification from photography. R. M. Hord and N. Gramenopoulos (Itek Corp., Lexington, Mass.). In: Remote sensing of earth resources and the environment; Proceedings of the Seminar-in-Depth, Palo Alto, Calif., November 8,

9, 1971.

Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1972, p. 41-48.

Description of the software features of a computerized terrain classification system developed for automatic interpretation of aerial photographic imagery. The input consists of a black and white aerial photograph that has been digitized by a laser scanning system. Small square grid elements of the photograph are assigned to one of four terrain types: cultivated, cloud covered, water, and uncultivated. Local average transmission, local spatial frequency information, global considerations, and derivative edge indicators are employed. The output consists of photographs overwritten with alphabetic assignment coding and/or enhanced edges. T.M.

A73-15775 Theoretical and experimental automatic exposure control study. R. Wakeman, M. Jackson, and S. Roth (Fairchild Camera and Instrument Corp., Syosset, N.Y.). In: Remote sensing of earth resources and the environment; Proceedings of the Seminar-in-Depth, Palo Alto, Calif., November 8, 9, 1971.

Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1972, p. 63-72.

Five descriptive statistical characteristics of selected aerial photographs were examined for the purpose of determining the usefulness of these quantities for the control of an automatic exposure system. The statistical quantities considered included the arithmetic mean, standard deviation, skewness, kurtosis, and a type criterion. The photographs represented cloud-free clear conditions and scattered-cloud haze-free conditions. The photos were digitized and processed by a computer to derive the statistical data. The arithmetic mean and the standard deviation were found to contain the necessary information for exposure decisions. T.M.

A73-15776 Automatic correlation of earth resources data - A pilot system design. E. Hart and R. Wakeman (Fairchild Camera and Instrument Corp., Syosset, N.Y.). In: Remote sensing of earth resources and the environment; Proceedings of the Seminar-in-Depth, Palo Alto, Calif., November 8, 9, 1971.

Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1972, p. 73-82.

Description of a prototype data processing system intended for automatic correlation of earth resources data collected from a variety of sensors, over a broad range of wavelengths, and from different gyrating vehicle platforms at different altitudes and times. This pilot system was primarily envisioned as a research and development tool consisting of an inexpensive, easily assembled configuration of equipment required for thorough experimentation with all stages of the film and magnetic tape handling process while accommodating all presently employed earth resources remote sensors. Block diagrams show the hardware arrangement, and brief descriptions are given for system operations involving data preprocessing, parameter processing, correlation processing, and accuracy estimates. Computer throughput estimates are tabulated for specific types of data. T.M.

A73-16289 Applications of the discriminant function in automatic pattern recognition of side-looking radar imagery. E. Y. Kedar and S.-Y. Hsu (New York, State University, Binghamton, N.Y.). In: Imaging techniques for testing and inspection; Proceedings of the Seminar-in-Depth, Los Angeles, Calif., February 14, 15, 1972.

Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1972, p. 145-148.

A73-17136 Investigation of color detail, color analysis and false-color representation in satellite photographs. H. S. Helbig (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Oberpfaffenhofen, West Germany). In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 274-291.

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A73-17143 On the question of automatic analysis of aerial photographs. I. S. Gorian and D. A. Ianutsh. In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 395-407. 8 refs.

Review of image investigation and classification methods based on the statistical characteristics of the images concerned measured by photometry and television techniques. The distribution of intervals among overshoots related to video signal contour elements is considered in great detail. It is shown that it contains by itself all the information on the energy spectrum of the video frequencies. Experimental results are presented. M.V.E.

A73-17145 Additive color techniques for the analysis of ERTS imagery. E. Yost (Long Island University, Greenvale, N.Y.). In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 438-459. 7 refs.

Consideration of the use of additive color viewing techniques in analyzing satellite photography of the earth's surface in four distinct spectral bands. An analysis is made of the operation of multispectral additive color viewers, noting the usefulness of colorimetric measurement when analyzing the image reproduction characteristics of a multispectral viewer. Particular mention is made of the Spectral Data Model 60 additive color viewer. The effects of photo processing on image color characteristics are considered, as well as the relation between image density and color. The results of an empirical evaluation of these theoretical considerations, using the Spectral Data Model 20 multispectral additive color viewer, are summarized. A.B.K.

A73-17146 The effects of picture operations in the Fourier domain and vice versa. J. L. Higgins and E. S. Deutsch (Maryland, University, College Park, Md.). In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 460-480. Research supported by the Allied Research Associates.

The paper discusses the effects various digital operations on a picture have on the corresponding Fourier Transform. The same operations performed in the frequency domain are investigated as to their effect on the resulting picture. The relationships between these effects and the picture content are presented. (Author)

A73-17147 A digital processing and analysis system for multispectral scanner and similar data. F. Y. Borden (Pennsylvania State University, University Park, Pa.). In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 481-507. 12 refs. Research supported by the Pennsylvania State University and Hatch Funds.

A data processing system was developed for processing airborne and satellite multispectral scanner remote sensor data. The system was developed for an IBM S/360 Model 67 computer with a variety of remote terminals. The use of aerial photographs was considered to be integral to the use of the system. Character maps are produced by each component of the system except for the statistics program which produces the statistical data used by other components and for other external statistical analyses. Line maps can be produced which correspond to any of the character maps. (Author)

A73-17148 Reducing variance in remotely sensed multispectral data - A pragmatic approach. W. L. Brown (Michigan,

University, Ann Arbor, Mich.). In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 525-537.

This paper discusses an approach to reducing the variance in multispectral scanner data caused by (1) high-frequency random noise, (2) low-frequency random noise, and (3) systematic variations in system angular response and in apparent scene radiance. The data itself is used as a basis for reducing its own variance. High-frequency random noise can be reduced through repetitive scanning of each object point and integrating the result. Low-frequency noise can be reduced by clamping and scaling to stable reference signals. Systematic angle effects can be minimized by computing an average scanline which assumes a generally parabolic shape and is taken to be an undesirable angle effect which can be divided into (or subtracted from) each individual scanline to restore normality to the apparent radiance of the scene. (Author)

A73-17149 * The use of a simulator in a synthetic aperture radar data processing tradeoff study. M. Lybanon (Computer Sciences Corp., Huntsville, Ala.). In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 550-580. 13 refs. Contract No. NAS8-21805.

A computer simulation of a synthetic aperture radar system is described. The objective in developing the simulator was to make it possible to assess the imaging performance of various configurations against a variety of target types. The simulation involves targets, the radar system itself, and the processor; several analysis and output options are provided. Targets may be internally generated or come from external sources, or externally produced (e.g., real) radar signals can be used. A number of parameters of the radar system can be varied. The characteristics of the processor can be adjusted to a considerable extent. Statistical analyses may be performed. Several output options are available, including imagery. (Author)

A73-17150 * Rapid processing of multispectral scanner data using linear techniques. R. B. Crane and W. Richardson (Michigan, University, Ann Arbor, Mich.). In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 581-595. Contract No. NAS9-9784.

Tests have been made to compare linear and quadratic techniques for processing multispectral scanner data. The tests have been limited to a few selected sets of agricultural data. Two aspects of processing were studied. The first, the selection of a subset of channels to be used in the decision function, was found to be faster by a factor of 50 when a linear method was used. Second, in recognition processing, our linear decision rule produced a lower error rate and utilized a larger number of channels for equal processing times. Nevertheless, when the criterion is lowest possible error rate, irregardless of processing time, the quadratic rule is preferable. (Author)

A73-17151 A model for spectral signature variability for mixtures. D. M. Detchmندی and W. H. Pace (TRW Systems Group, Houston, Tex.). In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 596-620.

This paper reports on some experimental results that have been obtained on the variability of spectral signatures. The interpretation of these results has led to the development of a model to explain the observed signature variability. This model is consistent with and is

reinforced by classification experiments based upon a clustering algorithm. All of the experiments reported in this paper are based upon multispectral scanner data collected in an actual flight. The experimental results obtained from the data, the variability of spectral signatures, and the clustering experiments are presented. Equations are developed for the signature model. Based upon this model, a geometric discussion of a new processing procedure is presented. (Author)

A73-17152 * Spatial frequency analysis of multispectral data. H. K. Ramapriyan (Computer Sciences Corp., Huntsville, Ala.). In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 621-644. 6 refs. Contract No. NAS8-21805.

This paper presents the definitions of texture dependent features which can be obtained in terms of the spatial frequencies of small sections of remotely sensed multispectral data. The features are made independent of the direction of view by defining them as symmetric functions of the spatial frequencies sensed with various viewing directions. Several textural features are defined and experimental results indicating existence of signatures in these features are presented. Preliminary experiments have been performed on the classification of 60 samples, 10 from each of the following 6 categories - grass, trees, water, staked tomatoes, treated ground tomatoes, and untreated ground tomatoes. Classifications of the training samples using only one feature at a time indicate that several of the features yield classification efficiencies higher than 65%. The efficiency increases considerably when combinations of these features are used. (Author)

A73-17153 * An integrated feature selection and supervised learning scheme for fast computer classification of multi-spectral data. A. D. Bond and R. J. Atkinson (Computer Sciences Corp., Huntsville, Ala.). In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 645-672. 10 refs. Contract No. NAS8-21805.

A73-17154 * Unsupervised classification of earth resources data. M. Y. Su, R. R. Jayroe, Jr., and R. E. Cummings (NASA, Marshall Space Flight Center, Huntsville, Ala.). In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 673-693. 17 refs.

A new clustering technique is presented. It consists of two parts: (a) a sequential statistical clustering which is essentially a sequential variance analysis and (b) a generalized K-means clustering. In this composite clustering technique, the output of (a) is a set of initial clusters which are input to (b) for further improvement by an iterative scheme. This unsupervised composite technique was employed for automatic classification of two sets of remote multispectral earth resource observations. The classification accuracy by the unsupervised technique is found to be comparable to that by existing supervised maximum likelihood classification technique. (Author)

A73-17155 The design of a universal data analysis system. S. W. Baker (Aerojet-General Corp., El Monte, Calif.). In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 702-721. 8 refs.

The characteristics of a universal data system for use with earth resource observation investigations are discussed. Particular emphasis is placed on processing image data. The input media of film, analog tape, multichannel, high-density digital magnetic tapes, and com-

puter-compatible tape (CCT) are considered. The output media to the investigator such as digitally driven video color display, color strip film, printed listings, and the CCT are covered. The control and monitor operations are developed with emphasis on data accessibility and man-machine interaction. Potential configurations of such a data system are presented. (Author)

A73-17158 * Radiation balance mapping with multispectral scanner data. W. A. Malila (Michigan, University, Ann Arbor, Mich.). In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 769-783. 17 refs. Contract No. NAS9-9784.

Energy budget and radiation balance relationships have been measured from the ground by investigators in several disciplines. Airborne and spaceborne multispectral sensors provide a new measurement capability for large-area synoptic mapping of these quantities. Procedures for estimating and mapping total exitance and radiation balance from multispectral scanner data are discussed, and example maps for an agricultural application are presented. This information extraction technique is an extension of the usual recognition mapping performed with multispectral scanner data, and represents a first step in the quantitative interpretation and assessment of surface conditions with remote sensor data. (Author)

A73-18155 # Random optical density fields pertaining to analyses of aerial photo imaging of aerial topographic objects (O sluchainykh poliakkh opticheskikh plotnostei primenitel'no k analizu aerofotoizobrazheniia ploshchadnykh topograficheskikh ob'ektov). V. S. Sokolo. *Geodezika i Aerofotogramka*, no. 3, 1972, p. 77-84. 8 refs. In Russian.

A73-18279 Optical processors and displays for synthetic aperture radar systems. J. S. Zelenka, W. D. Hall, and N. G. Massey (Michigan, Environmental Research Institute, Ann Arbor, Mich.). In: Annual Electro-Optical Systems Design Conference, 4th, New York, N.Y., September 12-14, 1972, Proceedings of the Technical Program. Chicago, Industrial and Scientific Conference Management, Inc., 1972, p. 45-55. 11 refs.

The fundamental concepts of imaging radar systems are reviewed. Particular attention is given to the use of coherent optical processing techniques for generating microwave imagery from raw radar data. A new coherent optical display technique is presented. This technique can preserve the large linear dynamic range associated with synthetic aperture radar systems. A new image-processing facility described makes use of a hybrid system which consists of a coherent optical processor connected to a digital computer by means of a digitally controlled image dissector. G.R.

A73-21707 * Natural resources information system. J. C. Leachtenauer (Boeing Co., Civil and Commercial Systems Div., Seattle, Wash.) and A. M. Woll (U.S. Department of the Interior, Minerals and Land Resources Working Group, Washington, D.C.). In: American Society of Photogrammetry and American Congress of Surveying and Mapping, Fall Convention, Columbus, Ohio, October 11-14, 1972, Proceedings. Falls Church, Va., American Society of Photogrammetry, 1972, p. 250-269. 5 refs. Research supported by the U.S. Department of the Interior and NASA.

A computer-based Natural Resources Information System was developed for the Bureau of Indian Affairs and Land Management. The system stores, processes and displays data useful to the land manager in the decision making process. Emphasis is placed on the use of remote sensing as a data source. Data input consists of maps, imagery overlays, and on-site data. Maps and overlays are entered using a digitizer and stored as irregular polygons, lines and points. Processing functions include set intersection, union and difference and area, length and value computations. Data output consists of computer tabulations and overlays prepared on a drum plotter. (Author)

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A73-23361 International Telemetry Conference, Los Angeles, Calif., October 10-12, 1972, Proceedings. Conference sponsored by the International Foundation for Telemetry, Instrument Society of America, and Electronic Industries Association. Woodland Hills, Calif., International Foundation for Telemetry (ITC Proceedings, Volume 8), 1972, 936 p. \$25.

Topics discussed include telemetry in the 1970s, urban communication systems, multiple access communication theory, tape recording techniques, digital phase-locked loops, communication satellite systems, data coding and processing, modulation techniques, biomedical telemetry, digital image transmission, space and terrestrial communication at optical frequencies, data collection and information networks, implant telemetry, practical applications of coding techniques, synchronization, range telemetry data quality improvement, telemetry processing and tracking systems, deep-space communications, and spacecraft component development.

Individual items are announced in this issue.

A.B.K.

A73-23391 Data compression for earth resources satellites. C. L. May and D. J. Spencer (TRW Systems Group, Redondo Beach, Calif.). In: International Telemetry Conference, Los Angeles, Calif., October 10-12, 1972, Proceedings. Woodland Hills, Calif., International Foundation for Telemetry, 1972, p. 352-362, 5 refs.

Description of an information-preserving data technique which is applicable to multispectral imagery such as that obtained by earth-resources satellites. The requirements for data compression in such missions are discussed, and a rationale is presented for the use of distortion-free information-preserving compression. The selected compression technique involves the use of the spectral-spatial-delta-interleave (SSDI) algorithm, a form of differential pulse code modulation, to eliminate gross spectral and spatial redundancies. These reduced data are then coded for transmission using either the Huffman or the Rice coding algorithms. The coding algorithms have been simulated using a portion of frame 3698 taken during the Apollo S065 experiment, and the results are presented. A parametric study presents the compression achieved by the SSDI-Rice algorithm as a function of block size and split-picture-element mode used. Implementation considerations are also given. (Author)

A73-23393 * 10-micrometer band communication terminals in space. N. McAvoy (NASA, Goddard Space Flight Center, Greenbelt, Md.). In: International Telemetry Conference, Los Angeles, Calif., October 10-12, 1972, Proceedings. Woodland Hills, Calif., International Foundation for Telemetry, 1972, p. 372-383, 20 refs.

Ten-micrometer band communication systems using CO₂ lasers for space to space links are discussed. Particular emphasis is on low earth orbiting earth observation satellites to geosynchronous satellites at high data rate. Four key technology areas are discussed: wideband mixers for Doppler tracking; tunable laser local oscillators; high data rate modulators; and laser transmitters. (Author)

A73-23398 * A very high speed hard decision sequential decoder. K. S. Gilhousen (LINKABIT Corp., San Diego, Calif.) and D. R. Lumb (NASA, Ames Research Center, Moffett Field, Calif.). In: International Telemetry Conference, Los Angeles, Calif., October 10-12, 1972, Proceedings. Woodland Hills, Calif., International Foundation for Telemetry, 1972, p. 499-506, 9 refs. Contract No. NAS2-6411.

Description of a 40-Mbps hard-decision sequential decoder for high-data-rate coding systems for earth-orbiting space missions with power-limited links. A prototype decoder has been designed and fabricated using the fastest commercially available digital integrated circuits, MECL III. Thus far, an internal computational rate of 70 million computations per second has been achieved. Computational efficiency of the decoding algorithm was greatly improved by incorporating two modifications to the Fano algorithm - 'double quick threshold loosening' and 'diagonal steps.' Preliminary results indicate that an output error rate of 0.00001 can be achieved with E

sub b/N sub zero less than 5.4 dB at data rates up to 40 Mbps. At lower data rates, even less signal energy is required. This decoder is believed to be at least five times faster than any previous sequential decoder. (Author)

A73-27864 # Photogrammetric solution for precision processing of E.R.T.S. images. V. Kratky (National Research Council, Ottawa, Canada). *International Society of Photogrammetry, International Congress for Photogrammetry, 12th, Ottawa, Canada, July 24-Aug. 4, 1972, Paper. 60 p. 20 refs.*

The imagery, formed aboard the Earth Resources Technology Satellite (ERTS) by the Return Beam Vidicon (RBV) cameras and by the Multispectral Scanning System (MSS), is radio transmitted to the earth and displayed by special reproducers. The geometry of both imaging systems is analyzed and an appropriate analytical solution is proposed that can provide corrections necessary for the precision processing of images. In the RBV case, particular attention is paid to the electronic distortion. The analytical formulation based on polynomial and projective transformation is shown to be capable of providing the scan line control, which is essential to the precision processing system adopted for the Canadian ERTS program. The geometry of MSS images is discussed in detail, with particular respect to the distorting effect of the earth rotation and to attitude changes of the sensor during the flight. (Author)

A73-29154 # Radiation temperatures of the earth's blankets in the microwave and infrared ranges according to experiment data on the Cosmos-384 artificial earth satellite (Radiatsionnye temperatury zemnykh pokrovov v SVCh i infrakrasnom diapazonakh po dannym eksperimenta na ISZ 'Kosmos-384'). A. E. Basharinov, A. K. Gorodetskii, A. S. Gurvich, S. T. Egorov, A. A. Kurskaya, D. T. Matveev, A. P. Orlov, and A. M. Shutko (Akademiya Nauk SSSR, Institut Radiotekhniki i Elektroniki and Institut Fiziki Atmosfery, Moscow, USSR). *Akademiya Nauk SSSR, Izvestiya, Fizika Atmosfery i Okeana*, vol. 9, Feb. 1973, p. 183-186. In Russian.

A73-33100 # Remote sensing and photo interpretation. J. E. Colcord. *Trend in Engineering*, vol. 25, Apr. 1973, p. 12-21, 25. 7 refs. U.S. Geological Survey Contract No. 14-08-001-12865.

This paper is designed to give an overview of the field of remote sensing to the engineer. It considers the problems of source, atmospheric attenuation, lens/filter/film or sensor sensitivity, reflectance of targets, and the presentation of data. The discussion covers visual wavelengths, black and white and color photography, the photographic or solar IR region, heat IR, and microwave imagery. Utilization of photo and other sensors for interpretation is considered, showing current trends and the potential of satellite systems such as the ERTS-A. (Author)

A73-33127 * Implementation of a frog's eye type discriminator, responsive only to pattern changes, as a pre-processor for visual data. E. E. Klingman, III (NASA, Marshall Space Flight Center, Space Sciences Laboratory, Huntsville, Ala.). In: Realism in environmental testing and control; Proceedings of the Nineteenth Annual Technical Meeting, Anaheim, Calif., April 2-5, 1973.

Mount Prospect, Ill., Institute of Environmental Sciences, 1973, p. 1-4.

A73-33366 Digital data processing and analysis. S. S. Viglione (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.). In: Operational remote sensing; Proceedings of the Seminar, Houston, Tex., February 1-4, 1972. Falls Church, Va., American Society of Photogrammetry, 1972, p. 208-244, 14 refs.

It is shown that digital processing of imagery from vehicles such as ERTS A and B can be expected to accomplish a multiplicity of functions ranging from merging ancillary and ephemeral data with the MSS and RBV imagery to actual automatic classification of specific features of objects in that imagery. Some of the described digital operations are placed in perspective for potential data users.

The emphasis is on procedures for image enhancement and analysis. The need for both man and computer processing of imagery and interactive man-machine analysis is stressed. Many of the techniques reviewed and results illustrated are shown to have been generated by just such interaction. M.V.E.

A73-33367 Hybrid techniques for automatic imagery interpretation. G. Swanlund (Honeywell, Inc., Systems and Research Div., Roseville, Minn.). In: Operational remote sensing; Proceedings of the Seminar, Houston, Tex., February 1-4, 1972.

Falls Church, Va., American Society of Photogrammetry, 1972, p. 245-255; Discussion, p. 256. 22 refs.

The purpose of this paper is to review the status of techniques which could automate portions of the data interpretation. A variety of laboratory equipments have been used to demonstrate the feasibility of automatic classification. Results have shown classification accuracies approaching those of humans. Hardware projections indicate processing rates 1 to 3 orders of magnitude faster than humans. A few programs have evaluated prototype units to process multispectral data on an extensive scale. In the main, however, the field has to be considered as emerging. Much research is required before operational systems can be developed. (Author)

A73-34285 Simulated ERTS data for coastal management. F. J. Wobber (Earth Satellite Corp., Washington, D.C.) and R. R. Anderson (Earth Satellite Corp., American University, Washington, D.C.). *Photogrammetric Engineering*, vol. 39, June 1973, p. 593-598.

In the anticipation of small-scale synoptic and repetitive ERTS-A image data, Apollo 9 and Gemini earth orbital imagery has been analyzed to develop ERTS information products that are useful in solving problems of coastal-zone management. Simulated earth resources survey imagery (i.e., Gemini and Apollo photography with supporting aerial photographs) were used to demonstrate how relatively raw data slices can be used in combination to generate otherwise obscure information for practical decision making in coastal areas. T.M.

A73-34934 # Processing techniques for environmental resource monitoring (Tecniche di elaborazione per il rilevamento delle risorse ambientali). B. Ratti (Telespazio S.p.A., Rome, Italy). In: The control of the terrestrial environment from space: International collaboration, methods and technologies; International Conference on Space, 13th, Rome, Italy, March 22-24, 1973, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1973, p. 141, 143-147. In Italian.

Review of the requirements to be met by an environmental resource monitoring system including in situ observations and observations made from aerial and space platforms. The proposed system must be capable of sampling at three levels and must provide useful data in times commensurate with the need for corrective action. Two essentially complementary methods of interpreting the data obtained by remote sensing techniques are described - namely, photointerpretation and numerical treatment of the images obtained. A project is described which is intended to make a contribution of experimental and methodological nature to the definition of a concept of regional coverage as a basic element for an operative system. A.B.K.

A73-34941 # Data processing systems for earth resources applications - A survey. G. Bressanin (Telespazio S.p.A., Rome, Italy). In: The control of the terrestrial environment from space: International collaboration, methods and technologies; International Conference on Space, 13th, Rome, Italy, March 22-24, 1973, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1973, p. 215, 217-224.

Review of the main data processing functions currently being applied to earth resources surveys. The functions reviewed include

data handling - to transform the raw data into a form suitable for further processing; preprocessing - to remove instrument effects from the data, to annotate the data, and to carry out specific processing functions which do not involve a decision-making process; processing - to perform a decision-making process such as feature extraction and classification; and the compilation of an on-line data bank which contains data files of spectral signatures and other pertinent information and can be used to retrieve information from the data base. A.B.K.

A73-35667 Digital data acquisition and processing from a remote magnetic observatory. R. C. Snare, D. J. Peters, P. J. Coleman, Jr., and R. L. McPherron (California, University, Los Angeles, Calif.). *IEEE Transactions on Geoscience Electronics*, vol. GE-11, July 1973, p. 127-134.

The instrumentation selected for the observatory consists of a three-axis fluxgate magnetometer system with an automatic offset system and two axes of induction coil equipment. The recording equipment used is considered together with the timing equipment, operational problem areas, data reduction problem areas, and aspects of spacecraft data transmission. Advantages of a network of magnetic observatories are discussed. However, there are also a number of problems associated with the operation of a remote observatory. G.R.

A73-36842 Validation of digital radar landmass simulation utilizing terrain elevation data compression. A. J. Grant (General Electric Co., Daytona Beach, Fla.) and B. L. Capehart (Tennessee, University, Knoxville, Tenn.). In: Summer Computer Simulation Conference, Montreal, Canada, July 17-19, 1973, Proceedings. Volume 2. La Jolla, Calif., Society for Computer Simulation, Inc., 1973, p. 1094-1102. 19 refs. Navy-supported research.

The objectives of the research described in this paper were to develop an objective evaluation method for determining the 'goodness' of various data compression techniques applied to radar landmass simulation data, to validate the objective evaluation method by comparison with a subjective evaluation performed by experienced radar operators and to compare the objective evaluation with the currently used terrain RMS error criteria. This research consisted of the computation of simulated radar shadow displays, the computation of various measures of 'goodness' which were combined in a performance criteria, and the subjective evaluation of the simulated displays. The objective evaluation method which was developed measures the 'goodness' of the data compression technique in terms of the usefulness of the simulated radar displays. The results obtained demonstrate the inadequacy of the terrain RMS error criteria and the degrading smoothing efforts introduced by polynomial data compression. (Author)

A73-38178 Processing of terrestrial resource information (Le traitement des informations concernant les ressources terrestres). J. L. Bessis (CNES, Paris, France). *La Recherche Spatiale*, vol. 12, July-Aug. 1973, p. 12-16. In French.

The data to be treated comes from three mechanical scanning devices which work in different wavelength bands. These devices are the LMD infrared radiometer, a Cyclope monospectral scanner, and a 10-band Daedalus multispectral scanner. The systematic visualization on film or photosensitive paper and the general organization of the initial processing are discussed. Visualization on a printer consists of a geographic representation of the measurement (numerical or physical value); the program used visualizes on a listing the data issued from the different scanners used. The breakdown in a computer of the available data is described. Particular treatments of data coming from the multispectral scanner are discussed, and an example of a specific processing operation is given. F.R.L.

A73-38179 The processing of photographic data (Le traitement des données photographiques). H. Cruchant (CNES, Paris,

07 DATA PROCESSING AND DISTRIBUTION SYSTEMS

France). *La Recherche Spatiale*, vol. 12, July-Aug. 1973, p. 17-19. In French.

The photographic work demanded within the frame of terrestrial resources operations is quite different from that practiced in image processing laboratories. The data processing commences before the chemical processing in the laboratory, and as early as the preparation of the aerial work. There are physical, chemical, and technical constants inherent in the installations which must be absolutely respected. The experimenter must be able to compare, with the maximum of freedom, two results on the same zone, separated in time.

F.R.L.

A73-38597 # Design concepts for an earth resources data management system. T. M. Ragland (U.S. Geological Survey, Washington, D.C.). *American Astronautical Society, Annual Meeting, 19th, Dallas, Tex., June 19-21, 1973, Paper 73-151*. 6 p.

In designing any data management system, a decision has to be made on what data makes up the data base. An earth resources data base can be anything from a very narrow and specialized one to one that contains all prime data and almost an infinite amount of ancillary data. A data management system should be designed to allow rapid retrieval and prompt processing of data into information for the user. It is considered that the data should be archived in digital form until the user's need for information is ascertained. On this basis the system can be designed to enable rapid retrieval and processing of the data to furnish information to meet the specific needs of the users.

F.R.L.

A73-38598 # Remote sensing data management from a user's viewpoint. W. H. Stevenson (National Marine Fisheries Service, Fisheries Engineering Laboratory, Bay Saint Louis, Miss.) and T. M. Vanselous (National Marine Fisheries Service, Southeast Fisheries Center, Miami, Fla.). *American Astronautical Society, Annual Meeting, 19th, Dallas, Tex., June 19-21, 1973, Paper 73-152*. 11 p.

Incorporation of remote sensing data into a working data bank with diverse inputs and varying user requirements requires thorough management attention and adequate planning, in addition to technical competence. The establishment and operation of an experimental data bank in conjunction with the National Marine Fisheries Service's Fisheries Engineering Laboratory's participation in the ERTS-1 Program are described. After a brief description of the flow of remotely sensed data into a system controlling all data, the established data management system is discussed, including sources, organization, coordination, data bank operation, and user products.

(Author)

A73-38713 International Conference on Communications, Seattle, Wash., June 11-13, 1973, Conference Record. Volumes 1 & 2. Conference sponsored by the Institute of Electrical and Electronics Engineers. New York, Institute of Electrical and Electronics Engineers, Inc. (ICC Conference Record. Volume 9), 1973. Vol. 1, 799 p.; vol. 2, 795 p. Price of two volumes, members, \$18.; nonmembers, \$24.

Recent developments in communications systems are described in technical papers dealing with the performance and design of specific systems currently in operation or under development, including details of coding, multiplexing, modulation, and detection schemes utilized. Topics considered include international direct distance dialing in telephone communications, digital data transmission techniques, future concepts for communications satellites, communications system theory, satellite transmission techniques and equipment, various diversity techniques, effects of intersymbol interference on communications system performance, signal synthesis, antennas and propagation topics, image processing and facsimile techniques, advanced microwave components, new developments in radio relay systems, communications in civilian aviation, and communications between computer systems.

T.M.

A73-38744 # DCS - A global satellite environmental data collection system. E. J. Claire (Harris-Intertype Corp., Melbourne,

Fla.). In: International Conference on Communications, Seattle, Wash., June 11-13, 1973, Conference Record. Volume 1.

New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 21-6 to 21-12. Contract No. NAS5-21622.

This paper presents a summary of the results of a comparative study of satellite data collection systems which utilize remote ground data collection platforms transmitting data directly to a satellite and down to low-cost direct read-out local user terminals. The general objective of the study was to evaluate cost and technical feasibility of five medium orbiting and six geo-synchronous satellite data collection system (DCS) configurations with varying degrees of spacecraft and local user terminal (LUT) complexity. The goal of trading spacecraft and LUT complexity was to determine practical feasible systems with low-cost terminals, yet with a reasonable overall system cost that would permit the broad worldwide utilization of a highly beneficial data collection system. Results presented include data collection system analyses, satellite and local user terminal designs, and estimated costs. A summary of the types of local users and their requirements is also included.

(Author)

A73-39835 # Enhancement of Earth Resources Technology Satellite (ERTS) and aircraft imagery using atmospheric corrections. R. D. Sharma (Michigan, Environmental Research Institute, Ann Arbor, Mich.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 137-152. 10 refs. Contract No. NAS9-9784.

The studies considered are concerned with the magnitude of the atmospheric effects in multispectral earth resources data taken by satellites and aircraft. The atmospheric effects are present in all space oriented and aerial data even in the so-called atmospheric 'windows' through which all sensors observe the ground. Atmospheric effects are quite varied and depend on several parameters. An atmospheric model developed by Turner et al. (1971) is discussed. The model is applied to the test site, which is located in North Dakota. The results are used to obtain atmospheric correction data for ERTS-1 scanner data.

G.R.

A73-39875 # The interpretation of multispectral imagery - An analysis of automated versus human interpretation techniques. R. D. Mower (Wright State University, Dayton; USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2.

Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 789-814. 11 refs. U.S. Geological Survey Contract No. 14-18-0001-12077; Grant No. DAAK02-68-C-0089. Project THEMIS.

Two very dissimilar techniques of multispectral image interpretation were tested to determine which was best able to classify test sites representing selected land use categories found in the tropical milieu of Puerto Rico. Test results achieved by human interpreters were compared with those obtained using an automated technique which employed image density measurements and computer analysis. The results of these tests seem to indicate that the two techniques were comparable.

(Author)

A73-39876 # Performance evaluation of multispectral scanner classification methods. R. B. Crane and W. Richardson (Michigan, Environmental Research Institute, Ann Arbor, Mich.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2.

Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 815-831. 5 refs.

The maximum likelihood decision rule with assumed normally distributed data was compared with different forms of linear decision rules applied to multispectral scanner data. One linear decision rule was found to be more efficient for recognition than the maximum

likelihood decision rule whenever both error rate and processing time are important. When only error rate is important, the linear decision rule produced approximately the same error rate as the maximum likelihood rule for non-training data. The best linear decision rule is designed to be used with a digital classifier. A second linear decision rule, applicable to analog classifiers, was only slightly less accurate. (Author)

A73-39879 * # An unsupervised classification technique for multispectral remote sensing data. M. Y. Su (Northrop Services, Inc., Huntsville, Ala.) and R. E. Cummings (NASA, Marshall Space Flight Center, Huntsville, Ala.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 861-879. 13 refs. Contract No. NAS8-27364.

Description of a two-part clustering technique consisting of (a) a sequential statistical clustering, which is essentially a sequential variance analysis, and (b) a generalized K-means clustering. In this composite clustering technique, the output of (a) is a set of initial clusters which are input to (b) for further improvement by an iterative scheme. This unsupervised composite technique was employed for automatic classification of two sets of remote multispectral earth resource observations. The classification accuracy by the unsupervised technique is found to be comparable to that by traditional supervised maximum-likelihood classification techniques. (Author)

A73-39880 * # Signature extension techniques applied to multispectral scanner data. R. F. Nalepka and J. P. Morgenstern (Michigan, Environmental Research Institute, Ann Arbor, Mich.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 881-893. 8 refs. Contract No. NAS9-9784.

Review of a number of spectral radiance signature extension techniques based on the concept of preprocessing the data to reduce the effects due to atmospheric effects, scanner look angle, etc. One of the promising methods studied to date involves using a ratio preprocessing transformation wherein the signals generated in adjacent spectral bands are ratioed on a point-by-point basis prior to classification. This method is easily and efficiently implemented and tests to date have yielded excellent results. Signatures have been successfully extended over 100+ miles, four days, different times of day, and very different atmospheric conditions. (Author)

A73-39881 * # Atmospheric model for correction of spacecraft data. R. E. Turner and M. M. Spencer (Michigan, Environmental Research Institute, Ann Arbor, Mich.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 895-934. 21 refs. Contract No. NAS9-12269.

Description of a radiative transfer model which has been used to correct Apollo photographic imagery for degradation arising from atmospheric scattering. The model was tested using aircraft scanner data, and an extrapolation was then made to spacecraft altitudes. Using standard meteorological data for the region of interest, it is possible to determine transmittance, path radiance, and total radiance from calculations made with the multiple scattering atmospheric model. Simple algorithms are presented which allow potential users of spacecraft sensor data to correct imagery for the deleterious effects due to the scattering of radiation under clear or hazy atmospheric conditions. (Author)

A73-39882 * # Classifying unresolved objects from simulated space data. R. F. Nalepka and P. D. Hyde (Michigan, Environmental Research Institute, Ann Arbor, Mich.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2. Ann Arbor,

Mich., Environmental Research Institute of Michigan, 1973, p. 935-949. Contract No. NAS9-9784.

A multispectral scanner data set gathered at a flight altitude of 10,000 ft. over an agricultural area was modified to simulate the spatial resolution of the spacecraft scanners. Signatures were obtained for several major crops and their proportions were estimated over a large area. For each crop, a map was generated to show its approximate proportion in each resolution element, and hence its distribution over the area of interest. A statistical criterion was developed to identify data points that may not represent a mixture of the specified crops. This allows for great reduction in the effect of unknown or alien objects on the estimated proportions. This criterion can be used to locate special features, such as roads or farm houses. Preliminary analysis indicates a high level of consistency between estimated proportions and available ground truth. Large concentrations of major crops show up especially well on the maps. (Author)

A73-39883 # On a model for optimal proportions estimates for category mixtures. C. R. Hallum (Lockheed Electronics Co., Inc., Houston Aerospace Systems Div., Houston, Tex.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2.

Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 951-958. 7 refs.

Limits on the refinement of ground resolution elements seen by a multispectral sensor, in some cases, significantly restrict the amount of useful information that can be extracted from the data when using standard processing techniques. From space altitudes, many of the ground resolution elements are individually comprised of a mixture of object categories and many of the data points generated by multispectral sensors are not characteristic of any one object category. Consequently, the need is evident for a model for relating a combination of categories to the individual categories which would permit a recovery of information. A recently formulated model which relates a mixture of object categories in a resolution element to the proportions of the individual categories is extended, and an algorithm for obtaining statistically optimal estimates is presented. (Author)

A73-39884 # A new method for evaluating and mapping colours in aerial photographs. H. S. Helbig (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Satelliten-elektronik, Oberpfaffenhofen, West Germany) and W. Tzschupke (Freiburg, Universität, Freiburg im Breisgau, West Germany). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 959-968.

Color aerial photographs are used for recognition of signatures from the hue. False-color IR film is used especially for forestry survey. For analysis and interpretation of these pictures a four-channel color scanner with high spatial resolution is used for an automatic selection of colors. The display may be either a B/W transparency or a color picture. This method of classification by mapping colors is applied in forestry survey to detect different phases of damage caused by air pollution, to evaluate the effects of fertilizing, and to classify types of trees and brushwood. (Author)

A73-39913 # Canada Centre for Remote Sensing ERTS Program. W. M. Strome (Department of Energy, Mines and Resources, Canada Centre for Remote Sensing, Ottawa, Canada) and E. Shaw (Computing Devices of Canada, Ltd., Ottawa, Canada). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 1497-1508.

During the past year, the Canada Centre for Remote Sensing has been established to coordinate remote sensing activity in Canada. The activity of the Center has been concentrated upon the

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acquisition of airborne remotely sensed data and the construction of a receiving station and data handling facility for the reception, processing and distribution of ERTS data. This paper presents a brief outline of the progress made in the development of a National Program on Remote Sensing for Canada during the past year, and a detailed description of the system developed to handle ERTS data. (Author)

A73-40820 # Remote sensing and spatial information systems. D. Steiner (Waterloo, University, Waterloo, Ontario, Canada). *COSPAR, Plenary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper. 24 p.* 122 refs.

Spatial information systems deal with data on phenomena distributed in geographical space. An assessment of the present state-of-the art regarding spatial information systems is presented, giving particular attention to the problem of integrating remote sensing data into spatial information systems. The principles of spatial information systems are considered, taking into account aspects of data specification, data acquisition, data input, storage, retrieval, processing, and output. The image data storage problem is discussed together with the geometrical base problem and the thematical data extraction problem. G.R.

A73-42732 An analysis of the earth's resources satellite /ERTS-1/ data. K. Ia. Kondrat'ev, O. B. Vasil'ev, A. A. Grigor'ev, and G. A. Ivanian (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR). *Remote Sensing of Environment*, vol. 2, no. 4, 1973, p. 273-283, 18 refs.

The analysis of information obtained with the Multispectral Scanning System of the ERTS-1 satellite in the form of images of the earth's surface (Northern California) in four spectral regions (channels) is presented. The problem of optimal choice of channels to obtain multispectral images of natural materials from space is discussed. On the basis of the analysis of calculations of the entropy of spectral intervals and observation conditions of the greatest spectral contrasts of natural materials, the following spectral intervals in the 0.4 to 1.0 micron wavelength region have been suggested as most informative: 0.54 to 0.56, 0.66 to 0.68, and 0.78 to 0.82 microns. (Author)

A73-43785 # The use of Skylab and ERTS data in an integrated natural resources development programme. J. L. van Genderen (Sheffield, University, Sheffield, England). *British Interplanetary Society, Journal*, vol. 26, Oct. 1973, p. 577-588. 29 refs. Research supported by the Royal Geographical Society and University of Sheffield.

An experimental procedure has been devised and is being tested for natural resource surveys to cope with the problems of interpreting and processing the large quantities of data provided by Skylab and ERTS. Some basic aspects of orbital imagery such as scale, the role of repetitive coverage, types of sensors, etc. are being examined in relation to integrated surveys of natural resources and regional development planning. Extrapolation away from known ground conditions - a fundamental technique for mapping resources - becomes very effective when used on orbital imagery supported by field sampling. Meaningful boundary delimitations can be made on orbital images using various image enhancement techniques. (Author)

N70-15687*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

A MODEL ATMOSPHERE FOR EARTH RESOURCES APPLICATIONS

David E. Pitts and Kirby D. Kyle. Nov. 1969 49 p refs (NASA-TM-X-58033) Avail: CFSTI CSCL04A

A computer subprogram set is described which permits the use of radiosonde data to provide model atmosphere data for earth resources applications. All earth resources remote-sensing techniques are affected by the atmosphere lying between the target and the sensor. The computer program presented in this report

offers a method of numerical use of radiosonde data so that atmospheric effects may be assessed and possibly removed from the signal. Author

N70-17429*# Fairchild Camera and Instrument Corp., Syosset, N.Y. Space and Defense Systems.

EARTH RESOURCES DATA PROCESSING CENTER STUDY. VOLUME 2: STUDY FINDINGS Final Report

15 Sep. 1969 308 p refs

(Contract NASw-1811)

(NASA-CR-107887; ED-AA-113) Avail: CFSTI CSCL08G

A review is presented of the basic objectives and requirements of the major government support agencies and experimenter groups associated with the Earth Resources Program, as well as the sensor and auxiliary equipments associated with the Manned Spacecraft Center aircraft survey program. Data flow models are developed which depict the processing of typical data from each sensor class through the associated MSC ground data processing facility. Future trends in the Earth Resources Program are delineated, with emphasis on the Houston aircraft program, its eventual coordination with spacecraft collection activities, and its attendant ground data processing requirements. Priority techniques, system and facilities growth requirements are identified. Development plans are presented to permit the timely research, development, construction and test of required processing equipment and facilities. Recommendations and conclusions concerning future effort aimed at furthering the growth of the earth resources data processing facilities at the Manned Spacecraft Center are developed. Author

N70-17721*# Fairchild Camera and Instrument Corp., Syosset, N.Y. Space and Defense Systems Div.

EARTH RESOURCES DATA PROCESSING CENTER STUDY. VOLUME 1: PROGRAM SUMMARY Final Report

15 Sep. 1969 47 p

(Contract NASw-1811)

(NASA-CR-107884; ED-AA-113) Avail: CFSTI CSCL08G

The results of a comprehensive study aimed at assisting NASA Headquarters in its task of planning R&D programs and developing an operational capability to acquire, process and disseminate remotely-sensed earth resources data to appropriate experimenters and users are described. A review is presented of the basic objectives and requirements of the major government support agencies and experimenter groups associated with the Earth Resources Program. Future trends in the Earth Resources Program are delineated, with emphasis on the Houston aircraft program, its eventual coordination with spacecraft collection activities, and its attendant ground data processing requirements. Recommendations and conclusions concerning future effort aimed at furthering the growth of the earth resources data processing facilities at the Manned Spacecraft Center are developed. Author

N70-20446*# Northwestern Univ., Evanston, Ill. Dept. of Geological Sciences.

A FORTRAN 4 PROGRAM FOR TWO-DIMENSIONAL AUTOCORRELATION ANALYSIS OF GEOLOGIC AND REMOTELY-SENSED DATA

W. B. Hemphins 11 Feb. 1970 59 p refs

(Grant NGR-14-007-027)

(NASA-CR-104213; Rept-21) Avail: CFSTI CSCL08F

The mathematical development and logic for computing a two-dimensional autocorrelation analysis of mapped data is given. Examples of usage of this type of analysis for studying mapped structures and testing statistical properties of trend surface maps and their residual maps are given. A FORTRAN IV computer program for the IBM OS 360/50 is listed. Operating instructions, sample data, and specimen output are also given in detail. Author

N70-21089*# Allied Research Associates, Inc., Concord, Mass. Geophysics and Aerospace Div.

MANAGEMENT, PROCESSING AND DISSEMINATION OF SENSORY DATA FOR THE EARTH RESOURCE TECHNOLOGY SATELLITE

Earl S. Merritt, Walter C. Ahlin, Leon Goldshlak, Jacques J. O. Palgen, Romeo R. Sabatini et al Dec. 1969 135 p
(Contract NAS5-10343)
(NASA-CR-109081; Rept-9G45-43; TR-11) Avail: CFSTI CSCL 09B

The elements of a data center for the management, processing and dissemination of photographic products generated by the Earth Resource Technology Satellite (ERTS) is specified. In addition to the specification of functional elements, this study examines and provides specification of: data rates and data flow time lines; facility, equipment and material requirements for a one-year operation over the Continental United States; and some preliminary analyses of photographic processing and materials that can influence picture element accuracies. A plan is presented for the further implementation steps necessary to provide an operating Data Center in time for an ERTS launch in early 1972. Author

N70-23540* National Academy of Sciences-National Research Council, Washington, D.C. Div. of Engineering.

USEFUL APPLICATIONS OF EARTH-ORIENTED SATELLITES: SYSTEMS FOR REMOTE-SENSING INFORMATION AND DISTRIBUTION. PANEL 8

Arthur G. Anderson (IMB, Yorktown Heights, N.Y.), Marvin S. Cohen (RCA, Princeton, N.J.), Sidney M. Foulks (Mobile Oil Corp., Dallas, Tex.), Harwood Kolsky (IBM, Palo Alto, Calif.), George J. Zissis (Michigan Univ., Ann Arbor) et al 1969 99 p refs
(Contract NSR-09-012-909)
(NASA-CR-109352) Avail: CFSTI CSCL 17B

The problems and potential for the use of data gathered by remote-sensing or distributed collection devices with collection from satellite or aircraft are considered. The considerations included the collection, processing, storage, and distribution of these data in both processed and raw form. In general, the problems considered focused primarily on those data processing aspects of the total system that lie between the receiving ground station and the user. Inevitably, however, broader judgments were reached on overall systems aspects, partly because of the need for mission planning and control in the data processing system, partly because of the inevitable need to designate operational priorities for the collection and dissemination of data. Author

N70-24085# Johns Hopkins Univ., Baltimore, Md. Dept. of Statistics.

TREND SURFACE ANALYSIS AND SPATIAL CORRELATION

Geoffrey S. Watson Sep. 1969 25 p refs
(Contract Nonr-4010(09))
(AD-899163; TR-124) Avail: CFSTI CSCL 8/2

The methods for analysing data in one dimension (usually time) are highly developed. However, in several dimensions, most applied workers only use one class of methods -- that in which the data is assumed to be the sum of a deterministic trend and an uncorrelated random error. The more general model with a spatially correlated error has been neglected in most fields -- oceanography is a conspicuous exception. This neglect is partly due to the lack of expositions for the applied workers. However, the manner in which much geological data is now collected does make this application difficult. The aim of this paper is to explain the relevance of the possible models and methods and to indicate their data requirements. An appendix has been added on Matherons work. Author (TAB)

N70-26900# Florida Atlantic Univ., Boca Raton. Dept. of Geography.
ELECTRONIC QUANTIFICATION AND COMPARISON

OF GEOGRAPHIC PATTERNS RECORDED BY VARIOUS REMOTE SENSORS, AND AN EVALUATION OF THEIR CONTRIBUTIONS TO GEOGRAPHIC RESEARCH AND METHODOLOGY Final Report, 1 Jan. 1965-31 Jan. 1970

James P. Latham 31 Jan. 1970 15 p
(Contract Nonr-4761(00))
(AD-700947) Avail: CFSTI CSCL 8/6

The report summarizes basic research program focused upon the electronic quantification and comparison of geographic patterns recorded by various remote sensors, and evaluates their contributions to geographic research and methodology. Eight technical reports cited with abstracts cover five years of experimentation analyzing photographic, radar, and thermal IR images via means of an instrumented system using television scanning, waveform analysis, and computer processing to establish feasibility of machine categorizing of geographic patterns from integrating data in images from one or more sensors. Author (TAB)

N70-27256# Joint Publications Research Service, Washington, D.C.

EXPEDIENT MEANS OF JOINT PROCESSING OF GROUND AND COSMIC TRIANGULATION

L. P. Pellinen *In its* Bull. of Opt. Artificial Earth Satellite Tracking Sta. 11 Mar. 1970 p 27 37 refs
Avail: CFSTI

Formulas are presented for accuracy estimation of the chord connecting remote points of the earth's surface by measurement data in the astronomical-geodetic network. When using corrected polygonal constructions the errors are decreased by 25-40 percent. It is recommended that photographic observations of the satellites be used to decrease geodetic construction errors, taking the vertical coordinates obtained from the ground measurements. The problem is solved for decreasing the distances between the observation stations and the flight altitude of the artificial Earth satellite. Author

N70-30925* Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.

MULTISPECTRAL DATA ANALYSIS Final Report

David S. Hanson and David R. Morganstein May 1970 129 p
(Contract NAS12-2123)
(NASA-CR-86409; BSR-2941) Avail: CFSTI CSCL 08H

Contour maps and prediction lines demonstrate the existence of water depth information in multispectral data, and further, that this information is recoverable. The technique of linear regression analysis proved to be the most useful tool applied to the information extraction problem. The physical parameters were studied and a mathematical model derived which suggests an exponential relation between reflectance and depth, thus posing initial restrictions on linear processing techniques. Measurable reflectance changes were shown to be asymptotic to a common value dependent only on scattering and absorption properties of the water. Multispectral data would not contain depth information beyond that value. Both time series and factor analysis were used to assist in the association of a depth measure with a set of reflectances, the latter being discussed in detail. E.M.C.

N70-34417*# TRW Systems Group, Redondo Beach, Calif. EARTH RESOURCES TECHNOLOGY SATELLITES, VOLUME 9 : CONFIGURATION MANAGEMENT PLAN Final Report

17 Apr. 1970 114 p
(Contract NAS5-11260)
(NASA-CR-109922) Avail: CFSTI CSCL 22B

The ERTS configuration, engineering drawing, specification, test procedure, baseline, and change identifications are considered for defining methods used to manage and segregate technical data for the total ERTS system. Configuration accounting is summarized for publication and issuance of reports emanating from the

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operational divisions and supporting functions. A system of informal and formal change controls for computer program configured items is examined, along with subcontractor configuration management. The method and procedure for identifying and listing the complete engineering data required to implement approved engineering changes for the ERTS project were established. J.A.M.

N70-34422* TRW Systems Group, Redondo Beach, Calif.
EARTH RESOURCES TECHNOLOGY SATELLITE. VOLUME 14: GROUND DATA HANDLING SYSTEM DESIGN
17 Apr. 1970 384 p
(Contract NAS5-11260)
(NASA-CR-109838) Avail: CFSTI CSCL 22B

The systems, subsystems, and operations, developed around a generic computer configuration, are described. The operation's concepts are described for the Operation Control Center, the NASA Data Processing Facility, computing and display services, and communications and data acquisition. Details are given on the equipment and the data processing for the OCC, NDPF, and the unified display system. The Automatic Data Processing Equipment configuration and computer software are discussed for the OCC and NDPF systems, along with load sharing, software organization, and capsule descriptions. N.E.N.

N70-34423* TRW Systems Group, Redondo Beach, Calif.
EARTH RESOURCES TECHNOLOGY SATELLITE. VOLUME 14 APPENDIX: OCC AND NDPF SPECIFICATIONS Final Report
17 Apr. 1970 165 p
(Contract NAS5-11260)
(NASA-CR-109918) Avail: CFSTI CSCL 22B

The specifications for design, performance, qualification, and acceptance test of the Operation Control Center Subsystem and for the NASA Data Processing Facility Subsystem are presented. The specification for the Ground Data Handling System personnel are also given and cover qualitative and quantitative requirements for position manning by organization functional elements, selection and training of personnel, and operation and maintenance manual requirements. Author

N70-34424* TRW Systems Group, Redondo Beach, Calif.
EARTH RESOURCES TECHNOLOGY SATELLITE. VOLUME 15: GROUND DATA HANDLING SYSTEM STUDY Final Report
17 Apr. 1970 71 p
(Contract NAS5-11260)
(NASA-CR-109924) Avail: CFSTI CSCL 22B

The Ground Data Handling System consists of two major elements. The Operation Control Center and the NASA Data Processing Facility. Several studies common to both are presented. A collocation of the OCC and NDPF is analyzed. Facilities, the use of floor space, hazardous times, cooling requirements, and related topics are studied. A digital TV system is analyzed for use in both centers and the requirements are given. Detailed studies are presented on the capacity required for each subtask to obtain the proper size of computer. The sizing was done with respect to the IBM 360. Author

N70-34427* TRW Systems Group, Redondo Beach, Calif.
EARTH RESOURCES TECHNOLOGY SATELLITE. VOLUME 17: NASA DATA PROCESSING FACILITY STUDIES Final Report
17 Apr. 1970 401 p
(Contract NAS5-11260)
(NASA-CR-109923) Avail: CFSTI CSCL 22B

The data required for system design of the NASA Data Processing Facility (NDPF) is provided. The studies cover not only the techniques which will be used in the final system, but also

include those techniques and devices which have been rejected. This provides the rationale upon which the selection of the final design have been made. Alternatives, performance, and problems of techniques are described. The function of the NDPF is to accept data collected by ERTS and to present this data to users, in usable form, properly annotated, and as free as possible from the errors and anomalies introduced by the sensors and the data handling system. It also maintains a library of all past data and the means to retrieve further processes and reproduce them on request. S.S.

N70-34428* TRW Systems Group, Redondo Beach, Calif.
EARTH RESOURCES TECHNOLOGY SATELLITE. VOLUME 18: AUTOMATIC DATA PROCESSING EQUIPMENT PROCUREMENT Final Report
17 Apr. 1970 37 p
(Contract NAS5-11260)
(NASA-CR-109916) Avail: CFSTI CSCL 22B

Design study specifications for the Earth Resources Technology Satellite require a preparation of the performance characteristics for the Automatic Data Processing Equipment (ADPE) and an issue for Requests for Quotation (RFQ) for the specified equipment, followed by evaluation of responses and selection of proposed equipment subcontractors. Detailed scoring results and discussion of the selection process is presented for some of the 25 companies to which RFQ's were issued. The evaluation process led to the recommendation by the Source Evaluation Board for selection of two IBM 360's and one XDS Sigma 5 for the ERTS ADPE. S.S.

N70-34451* General Electric Co., Philadelphia, Pa. Space Systems Organization.
EARTH RESOURCES TECHNOLOGY SATELLITE OPERATIONS CONTROL CENTER AND DATA PROCESSING FACILITY. BOOK 1: SYSTEMS STUDIES Final Report
17 Apr. 1970 471 p
(Contract NAS5-11529)
(NASA-CR-109909; Doc-70SD4226-BK-1) Avail: CFSTI CSCL 22B

The Earth Resources Technology Satellite Ground Data Handling System (GDHS) design study is documented, presenting in detail those analyses and tradeoffs required to arrive at a cost-effective design meeting all requirements. Summaries are given of the GDHS design; significant study results; an overview of the functional analyses, requirements, and specifications; and operations control center system design, subsystems, and installation/test and operations studies. Author

N70-34452* General Electric Co., Philadelphia, Pa. Space Systems Organization.
EARTH RESOURCES TECHNOLOGY SATELLITE OPERATIONS CONTROL CENTER AND DATA PROCESSING FACILITY. BOOK 2: SYSTEMS STUDIES Final Report
17 Apr. 1970 525 p
(Contract NAS5-11529)
(NASA-CR-109839; Doc-70SD4226-BK-2) Avail: CFSTI CSCL 22B

The NASA Data Processing Facility design studies and subsystems analyses are described. Author

N70-34453* General Electric Co., Philadelphia, Pa. Space Systems Organization.
EARTH RESOURCES TECHNOLOGY SATELLITE OPERATIONS CONTROL CENTER AND DATA PROCESSING FACILITY. BOOK 3: SYSTEM STUDIES Final Report
17 Apr. 1970 258 p
(Contract NAS5-11529)
(NASA-CR-109910; Doc-70SD4226-BK-3) Avail: CFSTI CSCL

228

Appendices for the NASA Data Processing Facility system study are presented and include the terrain altitude effects on grid rectification accuracy, information retrieval at scientific installations, information retrieval system for photographic data, free text inputs to utility routines, use of microform techniques, frequency space analysis of line scan systems, precision positioning experiment, and functional requirements of training set analysis computer programs. The NDPF installation, integration, and acceptance test activities are described. The NDPF support functions are discussed and include operational requirements, operational flow, operating timelines, organization, staffing, training, manuals, maintenance, and logistics. N.E.N.

N70-35831* Ohio State Univ. Research Education, Columbus. Dept. of Geodetic Science.

DATA ANALYSIS IN CONNECTION WITH THE NATIONAL GEODETIC SATELLITE PROGRAM (2) Semiannual Status Report, Feb. Jul. 1970

Aug. 1970 37 p refs

(Grant NGL-36-008-093: OSURF Proj. 2514)

(NASA-CR-110044; SASR-6) Avail: CFSTI CSCSL08E

Experiments concerning the use of SECOR observations on GEOS-1 taken from the Pacific Tracking Network are examined. The least square algorithm was used to solve satellite tracking problems using a redundancy of data. A theoretical analysis of adjustments in ranges was studied, as well as a problem related to improvement of existing triangulation systems using satellite super-control points. Latitude observations for detection of crustal movements of earth were analyzed. SECOR, SAO camera, C band radar, French laser, and BC-4 data are also being investigated. J.A.M

N70-36203* Arizona Univ., Tucson. Optical Sciences Center. **OPTICAL SCIENCES CENTER NEWSLETTER. VOLUME 4, NO. 1: DEDICATION ISSUE**

Jan. 1970 77 p refs

(AD-700318) Avail: CFSTI CSCSL20/6

Contents: The relationship of the Optical Sciences Center to mission-oriented agencies; Industrial relations; The academic program; The research program (lens design, pattern recognition, digital image processing, analog image processing, mathematical optics, thin film optics, earth resources photography, infrared research, quantum optics, physiological optics and visual perception, holography, electro-optical devices, glass and glass-crystalline optical materials, and predicting mirror deflections); Publications; Optical shop; and Building floor plans. TAB

Geographers have spent a large part of their time and effort to refine techniques of presenting surfaces of different kinds. Manually produced maps were the usual device. This kind of preparation was appropriate for most purposes as long as the number of maps demanded did not surpass the abilities of the total number of cartographers and draftsmen. In many cases manual preparation is no longer possible. Applicable spatial data are now available to an extent which surpasses all imaginable bounds. This demands new methods of automated data handling, typically separating the process of storage and retrieval of data. This paper will discuss certain points which apparently were not considered in previous studies of systems for automated storage and retrieval of spatial data. Author (TAB)

N70-36318* Harvard Univ., Cambridge, Mass. Lab. for Computer Graphics and Spatial Analysis.

GEOGRAPHY AND THE PROPERTIES OF SURFACES. SOME THOUGHTS ON OPTIMAL MAPPING AND CODING OF SURFACES Interim Report

Thomas K. Peucker 3 Nov. 1969 16 p refs *Its Papers in*

Theoret. Geography No. 34

(Contract N00014-67-A-0298)

(AD-704518; ONR-TR-34) Avail: CFSTI CSCSL8/2

Geographers have spent a large part of their time and effort to refine techniques of presenting surfaces of different kinds. Manually produced maps were the usual device. This kind of preparation was appropriate for most purposes as long as the number of maps demanded did not surpass the abilities of the total number of cartographers and draftsmen. In many cases manual preparation is no longer possible. Applicable spatial data are now available to an extent which surpasses all imaginable bounds. This demands new methods of automated data handling, typically separating the process of storage and retrieval of data. This paper will discuss certain points which apparently were not considered in previous studies of systems for automated storage and retrieval of spatial data. Author (TAB)

N70-38846* Geological Survey, Washington, D.C.

USE OF INFRARED IMAGERY AND COLOR PHOTOGRAPHY IN STUDY OF MISSILE IMPACT CRATERS

H. J. Moore, David Cummings, and D. E. Gault Apr. 1967 7 p refs *Its Tech. Letter NASA-75*

(NASA Order R-09-020-015)

(NASA-CR-85481) Avail: CFSTI CSCSL08G

Daylight infrared imagery in the 8 to 13 micron band and color photography obtained from aircraft overflights 2,000 feet above the local terrain were used to study craters produced by missile impacts. Preliminary evaluation gives the following results: (1) The ejecta from the craters were detected using both infrared imaging and color photography during daylight flights. (2) The ejecta from the craters were relatively cool because of high moisture contents resulting from local rain showers, and were paler than their surroundings. Author

N70-38887* Geological Survey, Denver, Colo.

RADAR IMAGERY OF CEDAR CITY: IRON SPRINGS AREA, UTAH Preliminary Report

Paul L. Williams Sep. 1966 18 p *Its Tech. Letter NASA-44*

(NASA Order R-09-020-015)

(NASA-CR-78780) Avail: CFSTI CSCSL08E

The area studied consists of about 800 square miles and includes the Hurricane Cliffs which mark the boundary between the High Plateaus on the east and the Basin and Range province on the west. The radar images were interpreted for topography, geology, cultural, and hydrologic features, and vegetation. It was found that topographic features are well expressed by radar shadows and, that where geologic contrasts are well expressed by topography, geologic interpretation is possible. Sketch maps and radar images are presented. N.A.S.

N70-38895* Geological Survey, Washington, D.C.

EVALUATION OF NIMBUS 1 HIGH RESOLUTION INFRARED RADIOMETER (HIRR) IMAGERY

M. A. Conti Apr. 1967 19 p refs *Its Tech Letter NASA-35*

(NASA Order R-09-020-011)

(NASA-CR-85482; NASA-35) Avail: CFSTI CSCSL17E

Photographs of geologic features imaged by the high resolution infrared instrument aboard Nimbus I are evaluated. These features include volcanic and thermal zones, terrain-thermal reversals, thermal soil patterns, and polar ice features. It is noted that poor resolution, small scale, and other factors severely limit the quality of the imagery and the detectability of geologic features on a worldwide basis. Features that can be identified are discussed, and reasons are given for the quality of the photography which is considerably inferior to low-altitude imagery. C.T.C.

N70-41123* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

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EKTACHROME AND EKTACHROME PHOTOGRAPHY OF THE TWIN BUTTES AREA, ARIZONA

John R. Cooper (US Geol. Surv., Denver, Colo.) Jan. 1968 14 p
Prepared by US Geol. Surv., Denver /ts Tech. Letter No. 88
(NASA Order R-09-020-011)
(NASA-TM-X-80780) Avail: NTIS CSCL08G

Ektachrome and Ektachrome infrared photography of the Twin Buttes area, Arizona (Test Site No. 15) was exposed January 9 and 10, 1968, during NASA Flight Mission No. 18. Photographs were compared with each other and with black-and-white aerial photographs (approximate scale 1:55,000) to determine the relative value of each in interpreting the geology. The advantages and disadvantages of Ektachrome and Ektachrome infrared are discussed. Author

N70-41124*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex. A PHOTO-MOSAIC OF WESTERN PERU FROM GEMINI PHOTOGRAPHY

Julius A. MacKallor (Geol. Surv., Washington, D.C.) Oct. 1967 18 p refs Prepared by Geol. Surv. /ts Interagency Tech. Letter NASA-87
(NASA Order R-09-020-013)
(NASA-TM-X-80598) Avail: NTIS CSCL08B

A mosaic was prepared from photographs taken during the Gemini 9 mission. The 1:1,000,000-scale photo-mosaic extends from the Sechura Desert in northern Peru to northern Chile and from the Pacific Ocean to the headwaters of the Amazon. In addition to a wide variety of geological features, such things as landslides, roads, snow fields, irrigated lands, jungle agricultural sites, archeological sites, and smoke (brush burning) have been identified on the photo-mosaic. A lineation, interpreted as a major fault, extends across several photographs and for several hundred miles. This mosaic will supplement existing conventional maps and aerial photographs. Mosaics of photographs taken from space should be of considerable interest to the scientific community and of immense practical use in the efficient management of natural resources. Author

N70-41125*# Geological Survey, Washington, D.C. TIME, SHADOWS, TERRAIN AND PHOTOINTERPRETATION

R. J. Hackman May 1966 29 p refs /ts Tech. Letter NASA-22
(NASA Order R-09-020-013)
(NASA-CR-75770) Avail: NTIS CSCL 14E

Recent lunar studies have suggested that greater enhancement of the terrain is apparent on photographs taken at very low sun angle. To illustrate the effect of sun angle in the photointerpretation of aerial photographs, a plaster terrain model was photographed at 10 degree increments of illumination, ranging from 70 degrees to horizontal. The resulting photographs show that as the angle of illumination is decreased, tone differences become less apparent. In contrast, the enhancement, by shadow effect, of the topography, especially the micro relief (texture), becomes more apparent. Although most photographs presently used in photointerpretation studies are taken with high-angle illumination, this study suggests that photographs of the terrain at both high and low sun altitude would provide the greatest amount of terrain intelligence for the photointerpreter, and that if only one picture can be taken, one with the sun angle at approximate 30 degrees would be the most satisfactory in showing both tone difference and relief enhancement owing to shadows. Author

N70-41141*# Geological Survey, Washington, D.C. EVALUATION OF EKTACHROME AND MULTIBAND PHOTOGRAPHY IN CALIENTE RANGE, CALIFORNIA

J. G. Vedder and E. W. Wolfe Aug. 1966 11 p /ts Tech. Letter

NASA-17

(NASA Order R-09-020-015)
(NASA-CR-77081) Avail: NTIS CSCL 14E

Comparisons of geologic features outstanding in multiband and Ektachrome images are described for the aerial photography test area. It is concluded that aerial Ektachrome photography would be valuable in mapping unknown terrain with color contrast of rocks, but on-site inspection would be necessary. The multiband method could be used to discern specific geologic features and has promise as a remote sensing tool for rapid quantitative analysis of such features as sedimentary facies. J.M.

N70-42370*# Ryan Aeronautical Co., San Diego, Calif. A STUDY TO DEFINE A SCATTEROMETER DATA PREPROCESSING SYSTEM Final Report

R. E. Chapman and F. J. Killion 31 Jul. 1970 277 p refs
(Contract NAS9-9723)
(NASA-CR-108638; Rept-74267-1) Avail: NTIS CSCL09B

The investigation reported was prompted by the immediate need for processed data from the four NASA scatterometers upon completion of a NASA remote sensor aircraft flight mission. The study shows unequivocally that an airborne real-time data preprocessor is capable of immediately producing accurate normalized radar backscattering area data of terrain for most missions. The feasibility of the data preprocessor is presented. A design of data preprocessor incorporating modern techniques and components has been accomplished which is compatible with the NASA aircraft systems. The following important advantages are possible with the addition of the airborne data preprocessor: (1) an estimated 82% reduction in processing time; (2) an estimated 75% to 80% reduction in processing cost; (3) a quick-look, airborne display; (4) improved accuracy and reliability of radar backscatter (sigma-zero) data; (5) greater data-gathering flexibility; and (6) lower aircraft operations cost. Author

N71-10665# Technology, Inc., Dayton, Ohio. ANALYSIS OF DATA DENSITY AND STORAGE REQUIREMENTS FOR HIGH RESOLUTION RADAR SIMULATION SYSTEM DESIGN Final Report, Feb. 1969 Feb. 1970

Patrick D. Fligor Wright-Patterson AFB, Ohio AFHRL Jun. 1970 144 p refs
(Contract F33615-69-C-1363)

(AD-711385; AFHRL-TR-70-12) Avail: NTIS CSCL 17/9

The state-of-the-art was sampled to determine whether modern, commercially available computers with mass data storage units offered the potential for simulation of the performance of high-resolution radar systems. This effort was primarily concerned with the data storage for urban areas since such areas would place the severest burden upon the digital storage and computation system. Selected areas of New York City and San Francisco were analyzed from aerial photographs, and 74,000 dimensional readings were taken to form the basis for the conclusions given in this report. The analysis of results based upon extrapolations indicated the feasibility of system simulation from the standpoint of data storage and access time of modern computers. Author (TAB)

N71-10888# Ohio State Univ., Columbus. Dept. of Geodetic Science.

AN ALGORITHM FOR GRIDGING SATELLITE PHOTOGRAPHS Final Report

Lee U. Bender Apr. 1970 165 p refs
(Contract DI-14-08-0001-11996)

(PB-193314; DGS-135; USGA-TD-70-004) Avail: NTIS CSCL 08B

The report includes a computer program written in FORTRAN 4 (G) for the IBM 360/65. Its purpose is to compute photo coordinates of automatically selected UTM or geographic ground coordinates. Camera inner orientation need not be known, and first approximations to outer orientation need not be supplied. Author (USGRDH)

N71-11594# Radio Corp. of America, Princeton, N.J.: Astro Electronics Div.

GROUND DATA-HANDLING SYSTEM STUDY FOR THE EARTH RESOURCES OBSERVATION SATELLITE. PHASE 2: USER DATA PROCESSING REQUIREMENTS Final Report H. Gurk, P. Wood, and C. Smith 20 Nov. 1969 132 p refs (Contract DI-14-08-0001-11915)

(PB-193666; AED-R-3515) Avail: NTIS CSCL 09B

The ground data handling aspects of the EROS Program are considered from the users point of view. The type of processing that would be most useful to the user for their analysis and interpretation, the techniques that are currently available or can be developed to accomplish this processing is discussed. The data needs of two potential EROS-data users, the Tennessee Valley Authority and the Desert Research Institute of the University of Nevada, were investigated in detail. Author (USGRDR)

N71-11983*# Purdue Univ., Lafayette, Ind. Lab. for Agricultural Remote Sensing.

AUTOMATIC PROCESSING OF EARTH RESOURCE DATA D. A. Landgrebe In NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 2 1969 32 p Avail: NTIS CSCL 09B

The research of the Laboratory for Agricultural Remote Sensing (LARS), established to develop knowledge and techniques necessary to design an earth resource system utilizing aerospace platforms, is discussed. Studies are conducted in instrumentation and measurement, data processing, basic studies regarding the nature of earth surface materials, and consideration of user requirements for information generated by such a system. Progress in data processing studies is broken down into six segments: (1) improvements in LARSYS, the LARS programming system, (2) initiation of a system parameter sensitivity study, (3) the digital image display system, (4) data registration, (5) a new data classification scheme, and (6) a boundary-finding algorithm for multispectral data. Author

N71-11991*# Kansas Univ., Lawrence.

RADAR AND DATA PROCESSING

Richard K. Moore In NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 2 1969 28 p refs

Avail: NTIS CSCL 171

Progress is reported on radar and data processing research to determine the best design of space radars for earth resources application for different types of spacecraft, and to develop means for automatic processing of the large quantity of multi-image data from the radars and other sensing systems. The various possible spacecraft radars and tradeoffs involved between the various parameters are evaluated. To assist in understanding the empirically derived information from the aircraft measurements, a continuing study of the fundamentals of radar scattering from natural surfaces and simplified surface models is conducted. Analog and digital systems for processing multi-image data are discussed. R.B.

N71-15774# Joint Publications Research Service, Washington, D.C.

PROCESSING AERIAL PHOTOGRAPHS ON PHOTOGRAMMETRIC INSTRUMENTS USING ADJUSTABLE VALUES

V. B. Dubinovskiy et al In its Soviet and Bulg. Photogrammetric Tech. 4 Dec. 1970 p 14-18

Avail: NTIS

Using known elements of outer orientation of a pair of aerial photographs for constructing a terrain model and orienting

the model relative to the geodetic coordinate system, the aerial photographs and work sheet can be placed into the photogrammetric instrument according to the elements of orientation. Analytical methods of spatial phototriangulation, based on the use of a stereocomparator and electronic computer, are considered. The use of adjustable values makes it possible to change the orientation of the aerial photographs in the photogrammetric instrument. R.B.

N71-16154*# Purdue Univ., Lafayette, Ind. Lab. for Agricultural Remote Sensing.

DATA PROCESSING PROGRAMS AT LARS-PURDUE

D. A. Landgrebe In NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 2 1968 24 p

Avail: NTIS CSCL 08F

A primary mission of the data processing programs group, working in concert with the other four Laboratory for Agricultural Remote Sensing program areas, is to establish the existence of uniquely characteristic earth surface features of importance of agriculture. Initial efforts have concentrated on developing such a capability for the identification and measurement of important crop types in temperate zones. Other identification tasks of economic importance include soil mapping, identification of water bodies, detection of stressed vegetation conditions, and general landscape mapping. Feasibility studies to date indicate that the most promising set of characterizing features include stable, precise measurements of radiance of each scene-resolution element simultaneously in multiple wavelength bands. Author

N71-16620# Development and Resources Transportation Co., Silver Spring, Md.

AUTOMATIC PROCESSING OF ARCTIC PACK ICE DATA OBTAINED BY MEANS OF SUBMARINE SONAR AND OTHER REMOTE SENSING TECHNIQUES Technical Report, 1 Dec. 1969 - 15 Sep. 1970

Leonard A. Le Schack, William D. Hibler, and Frederick H. Morse Sep. 1970 57 p refs

(Contract N00014-70-C-0110)

(AD-713911; D/RT-5) Avail: NTIS CSCL 8/12

Automatic processing and analysis of three types of remote sensing data of arctic pack ice are described. The primary emphasis is on upward-looking sonar profiles of the underside of pack ice obtained during the winter 1960 arctic cruise of the SSN 583, SARGO. Two traverses, one in the Chukchi Sea and one in the Beaufort Sea were studied. Segments of the profiles were analyzed by power spectrum and frequency distribution of amplitude techniques. Power spectrum analysis indicated preferred spacing of pressure ridges with apparent periods of 20-25, 35-40 and 80-100 m. Comparison of the power spectra of two profiles intersecting at a right angle showed the expected spatial period shift of significant ice ridge ensembles and so suggests a potential real-time technique for determining, from submarines cruising submerged, ice ridge orientation. Author (GRA)

N71-17870*# Raytheon Co., Alexandria, Va.

ANALYSIS OF MULTI-SENSOR DATA, 12 SEPTEMBER - 11 DECEMBER 1968

Edward T. Huffman, Charles A. Bay, and Richard F. Pascucci Dec. 1968 57 p refs Supported in part by NASA and Office of Emergency Preparedness Original contains color illustrations (Contract DI-14-08-0001-1,1505)

(NASA-CR-116425; OEP-3311) Avail: NTIS CSCL 14E

The results are presented of assessments made of multi-sensor imagery obtained, for the most part, from the interdisciplinary NASA Earth Resources Aircraft Program. The imagery studied was: black-and-white, color, color infrared, multiband, and thermal infrared. Specifically, the analysis was conducted for the purpose of: (1) determining the level of detail interpretable from each type of

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sensor record; (2) examining industrial, urban and other cultural activities and installations for unique spectral signatures; and (3) determining the applicability of each type of sensor record to functional and structural analysis and to the post-emergency analysis of earthquake damage. Author

N71-19253* Geological Survey, Tampa, Fla.
**APPLICATION OF COMPUTER PROCESSED
MULTISPECTRAL DATA TO THE DISCRIMINATION OF
LAND COLLAPSE (SINKHOLE) PRONE AREAS IN FLORIDA**
A. E. Coker, R. Marshall, and N. S. Thomson / In NASA. Manned
Spacecraft Center 2d Ann. Earth Resources Aircraft Program
Status Rev., Vol. 1 1969 17 p refs Prepared in cooperation
with Michigan Univ., Ann Arbor
(NASA Order R-146-09-020-011)
Avail: NTIS HC\$6.00/MF\$0.95 CSCL 08G

The study of land collapse phenomena using remote sensing techniques is discussed. Data obtained using the multispectral scanner systems consisted of various combinations of 18 spectral bands ranging from 0.4 to 14.0 micron and several types of photography. Patterns that are hypothesized to be indicators of deeply buried relic sinks were chosen from photographic strips of the imagery representative of the 18 spectral bands. The data were processed for recognition of soil and vegetation characteristics through use of a multispectral computer processor. Author

N71-19254* Geological Survey, Washington, D.C.
**DIGITAL COMPUTER TERRAIN MAPPING FROM
MULTISPECTRAL DATA, AND EVALUATION OF PROPOSED
EARTH RESOURCES TECHNOLOGY SATELLITE (ERTS)
DATA CHANNELS, YELLOWSTONE NATIONAL PARK:
PRELIMINARY REPORT**
Harry W. Smedes, Kenneth L. Pierce, Marc G. Tanguay, and Roger
M. Hoffer / In NASA. Manned Spacecraft Center 2d Ann. Earth
Resources Aircraft Program Status Rev., Vol. 1 1969 37 p
refs
Avail: NTIS HC\$6.00/MF\$0.95 CSCL 08G

Digital computer processing of 12 wavelength bands of visible and reflective infrared scanner data has resulted in successful automatic computer mapping of eight terrain units in a Yellowstone National Park test site. Target areas in the scene were selected for training the computer. Statistical parameters of radiance such as mean, standard deviation, divergence, and covariance were computed for each category of material. These data were used in the computer program to determine which channels are most useful for recognition of all object categories studied, and to actually classify all the unknown data points into the known categories. The following terrain types have been mapped with greater than 80 percent accuracy in a 12-square-mile area with 1,800 feet of relief: (1) bedrock exposures, (2) talus, (3) vegetated rock rubble, (4) glacial kame terrace, (5) glacial till, (6) forest, (7) bog, and water, and (8) shadows. In addition, shadows of clouds and cliffs are depicted. Author

N71-19267* California Univ., Riverside. Dept. of Geography.
**SURFACE ENERGY EXCHANGE PHENOMENA
INTERPRETED FROM IR EXPERIMENTS**
Robert W. Pease / In NASA. Manned Spacecraft Center 2d Ann.
Earth Resources Aircraft Program Status Rev., Vol. 1 1969 16 p

Avail: NTIS HC\$6.00/MF\$0.95 CSCL 07E

The feasibility of separating multispectral images from multilayer film, utilizing techniques that have long been a part of the graphic arts, was investigated. Advantages of the separation process are: (1) The potential bank of multispectral data is greatly increased. (2) A single lens, single camera can be substituted for

the more elaborate clusters. (3) Registration or congruency of images is automatic. (4) Better contrast is obtained in the green band, subject to deterioration by air luminance. A.L.

N71-22343# Boston Coll., Chestnut Hill, Mass.
**RESEARCH DIRECTED TOWARD THE COLLECTION,
REDUCTION AND EVALUATION OF GEOMAGNETIC FIELD
DATA AND ELECTRIC FIELD PHENOMENA, ATMOSPHERIC
AND TERRESTRIAL** Final Report, 1 Nov. 1967 - 31 Oct.
1970
Peter D. Prevett 9 Nov. 1970 63 p refs
(Contract F19628-68-C-0100)
(AD-717779; AFCRL-70-0656) Avail: NTIS CSCL 8/14

The report deals with the study of the earth's geomagnetic field at both low and high altitudes. Part of the study was implemented using sub-orbital rocket payloads which contained airborne magnetometers, electric field devices, and a particle counter. The data was FM multiplexed over a telemetry link to the ground station where it was recorded in analog form on magnetic tape. Author (GRA)

N71-23069 Karlsruhe Univ. (West Germany). Institut fuer
Nachrichtenverarbeitung und Nachrichtenuebertragung.
**THE KARLSRUHE SYSTEM FOR AUTOMATIC IMAGE
PROCESSING**
H. Kazmierczak and F. Holdermann / In AGARD Principles and
Pract. of Bionics 1968 p 293-308 refs

Copyright. Avail: Technivision, Braywick House, Maidenhead,
Berks, Engl. US Distributor: Circa Publications Inc., 415 Fifth Ave.,
Pelham, New York 10803 (Attn. Mr. A. L. Candido)

The task of photointerpretation for the purpose of object recognition consists in processing pictorial information and in automatically recognizing and localizing objects such as cultivated areas, housing and industrial areas, bridges, streets or cars in the streets. The research made in this field exclusively aims at basic explorations in the field of picture recognition. The described system for automatic photointerpretation is a scanning and preprocessing system under computer control. Commands concerning film transportation, scanning mode and screen resolution are sent from the computer to the special computing unit and to the scanner by channel one. The scanned and preprocessed information is transmitted by channel two into the computer, where it is stored and processed. Channels one and two are multiplexing channels of the computer Control Data 3300 with a high transmission rate. Author

N71-23305# Hawaii Inst. of Geophysics, Honolulu.
**A REPORT ON THE PROCESSING OF AIRCRAFT
EXPENDABLE BATHYTHERMOGRAPH DATA** Final Interim
Technical Report, 1 Jan. 1968 - 31 Dec. 1970
Richard C. Latham 15 Jan. 1971 44 p
(Contract N00014-67-A-0387-0004)
(AD-718393; ITR-5) Avail: NTIS CSCL 8/10

The temperature profiles obtained by Aircraft Expendable Bathythermographs (AXBT) on a flight from Oahu to Kodiak on 18 March, 1970, are presented together with the temperature section and the sound velocity section obtained by calculation using probable salinity values as derived from other sources. The resulting near-surface, short-range sound transmission conditions are described and their relative importance in the long-range transmission of sound is discussed. A detailed description is provided of the method which has been developed to plot temperature profiles from the magnetic tape record of AXBT drops with output accuracy of one-tenth degree Celsius at each four meters of depth. The increase in accuracy and the savings in manpower and time are significant. The quickly-achieved graphic display of the temperature profile permits ready analysis of the AXBT record. Author (GRA)

N71-26643*# Boeing Co., Houston, Tex.
THE VIPS ADDRESSABLE INTERFACE UNIT Final Report
 Dale A. Maakenson 5 Apr. 1971 122 p
 (Contract NAS9-9347)
 (NASA-CR-114997; Rept-5-2934-HOU-290) Avail: NTIS CSCL 09D

An addressable interface was designed, installed and tested in GRE 1. The interface provides the necessary logic circuitry to permit control and monitoring of GRE functions by a digital computer. The hardware produced consisted of interface circuits installed in GRE 1 and two cards of digital logic circuits, one for the GRE and one for the IBM 2701 interface. In developing the GRE interface, a generalized addressable interface was developed which is extendable to all of the computer and peripheral equipment in the Visual Information Processing System. Specifically, the concepts developed were the command and data bus format, the line driver/receiver party line interconnection of the interface cards, the power distribution and grounding plan, and the initial layout of the packaging cards and the card file chassis. Author

N71-26651# Geological Survey, Washington, D.C.
AN EVALUATION OF ANALOG TECHNIQUES FOR IMAGE REGISTRATION

Robert B. McEwen *In its* Geol. Surv. Res. 1970, Chapter D 1970 p D305-D311 refs
 Avail: SOD\$3.75

Registration of multispectral images of the earth transmitted by three Return Beam Vidicon television cameras carried in a 980-km polar orbit in 1972 by the first Earth Resources Technology Satellite will require careful calibration of distortion parameters. The parameters, the expected distortions, and the desired calibration accuracies are listed. Four analog techniques considered and evaluated are (1) optical projection and rectification, (2) line-scan modulation, (3) orthophoto image correlation, and (4) analytically controlled transformations of incremental areas. The last offers the best approach for analog image registration. Author

N71-28003*# Fairchild Space and Defense Systems, Syosset, N.Y.

AUTOMATIC DATA CORRELATION SYSTEM STUDY. VOLUME 2: SYSTEM DESIGN Final Report, 1 Jul. 1969 -30 Jun. 1970

24 Jul. 1970 298 p
 (Contract NAS9-9842)
 (NASA-CR-115063) Avail: NTIS CSCL 09B

A design study for an automatic data correlation system of the Earth Resources program is presented. The problems of correlating remotely sensed earth surface data with other similar data and of correlating these data with the earth's surface are considered. A functional ground data processing system is described which is designed to handle all identified classes of remote sensor data on a large-volume, high-throughput basis. With that as a reference, a specific pilot system configuration is recommended which, where possible, uses equipments already available. Author

N71-28004*# Fairchild Space and Defense Systems, Syosset, N.Y.

AUTOMATIC DATA CORRELATION SYSTEM STUDY. VOLUME 1: PROGRAM SUMMARY Final Report, 1 Jul. 1969 -30 Jun. 1970

24 Jul. 1970 57 p refs
 (Contract NAS9-9842)
 (NASA-CR-115062) Avail: NTIS CSCL 09B

The problems of correlating remotely sensed earth surface data with other similar data and of correlating these data with the earth's surface are summarized. A functional ground data processing system is described which is designed to handle all identified classes of remote sensor data on a large-volume, high-throughput basis. With that as a reference, a specific pilot system configuration

is recommended which, where possible, uses equipments already available. Author

N71-29883*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

ONBOARD SPACECRAFT OPTICAL DATA PROCESSING
 A. S. Husain-Abidi Jun. 1971 22 p Presented at NASA and Opt. Soc. Am. Conf. on Holography and Opt. Filtering, Huntsville, Ala.

(NASA-TM-X-65603; X-711-71-259) Avail: NTIS CSCL 14C

The use of hybrid optical-digital systems for use on Earth Resources and Planetary spacecraft is explored. Attributed an onboard spacecraft optical system must possess low power, ruggedness and absence of mechanical or photographic links. With onboard satellite use in mind, a unique system has been designed. The main features of the system are the use of off-axis parabolic mirror segments as collimating Fourier transforming and image reconstructing elements, and a gallium arsenide laser diode as a point source of coherent electromagnetic radiation. Performance of this system for generating Fourier transform relationship and spatial filtering are very encouraging. Author

N71-31836*# Air Force Cambridge Research Labs., Bedford, Mass. Terrestrial Sciences Lab.

IMPROVEMENT OF THE GEOS-1 NORTH AMERICAN TRACKING NETWORK FROM MULTIPLE SHORT ARC GEODETIC ADJUSTMENTS

George Hadgigeorge *In* NASA, Goddard Space Flight Center Proc. of the GEOS-2 Program Rev. Meeting, Vol. 1 Nov. 1970 p 233-266 refs *Its* Environ. Res. Papers No. 315

(AFCL-70-0090) Avail: NTIS HC\$6.00/MF\$0.95 CSCL 08E

Combinations of 171 passes were employed in a short arc geodetic adjustment to improve the survey coordinates of 29 observing stations. The recovery of the station positions and their standard errors along with other geodetic parameters are presented. The results of this adjustment show a mean standard error of approximately 3.5 meters, and corrections to NAD survey coordinates basically consistent with the observation network with the origin at Hunter AFB. Author

N71-33209*# Geological Survey, Menlo Park, Calif.

AN EVALUATION OF ENHANCEMENT OF LIGHT INTENSITY DIFFERENCES ON COLOR AERIAL PHOTOGRAPHS AND THERMAL INFRARED IMAGERY FOR THE OZETTE ISLAND: CAPE ALAVA AREA OF THE OLYMPIC COAST OF WESTERN WASHINGTON

Richard J. Janda Mar. 1971 30 p refs
 (NASA Order R-09-020-015; NASA Order N62306-70-C-0200)
 (NASA-CR-121430) Avail: NTIS CSCL 08C

In a test of the utility of light intensity separated images in evaluating the natural resources of geologically complex coastal areas, 17 splits were obtained from the original color photograph and 13 splits were obtained from the original thermal infrared image. A comparison was then made between the splits and features mapped from the original photograph and image to see if the separated images or combinations enhanced or hindered perception of these features. Lists of features enhanced and hindered are included. The conclusion is drawn that this enhancement technique does not generate significantly more useful information than can be obtained from the original photograph and image in this area. However, the combined use of color aerial photographs and infrared imagery does generate significant new information. Author

N71-34990*# North American Rockwell Corp., Downey, Calif. Space Div.

ERTS CLOUD COVER STUDY Final Report, Jan. 1970 -

07 DATA PROCESSING AND DISTRIBUTION SYSTEMS

Mar. 1971

C. D. Martin and B. Liley Mar. 1971 303 p

(Contract NAS5-11231)

(NASA-CR-121770; SD-71-311) Avail: NTIS HC \$6.00/MF \$0.95 CSCL 03B

The results of a study to develop cloud statistics and probability-of-seeing values especially applicable to Earth Resources Technology Satellites (ERTS) are reported. Basic cloud statistics developed in a prior NASA-MSFC funded study were adjusted to the ERTS field-of-view and probability-of-seeing values were determined for single look, one- or two-look, and continuous viewing (look on every pass) modes. The cloud statistics adjustment for variable sensor resolution in terms of variable sizes of cloud-free viewing elements was developed from U-2, Apollo, and ESSA photographs. The validity of the U.S. homogeneous cloud regions was studied and recommendations for improvement for ERTS viewing are made. Author

N71-35510* Allied Research Associates, Inc., Concord, Mass. Geophysics and Aerospace Div.

APPLICATIONS OF OPTICAL PROCESSING FOR IMPROVING ERTS DATA, VOLUME 1

Jack J. O. Palgen Oct. 1970 40 p refs 3 Vol.

(Contract NAS5-10343)

(NASA-CR-121978; TR-16-Vol-1; ARA-9G45-68-Vol-1) Avail: NTIS CSCL 14B

An optical noise diagnosis technique for improvement of data received from Earth Resources Technology Satellites is described. A photographic negative or positive in an optical data processor modifies the amplitude or phase of incident coherent light producing a diffraction pattern. The diffraction patterns reflect any sinusoidal pattern in the image. Measurements of the diffraction patterns can provide a quantitative measure of the noise in the image. Author

N71-36153* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ERTS IMAGE BOUNDARIES

Gerald J. Grebowsky Jul. 1971 27 p

(NASA-TM-X-65684; X-560-71-309) Avail: NTIS CSCL 14E

Since the scanning of a ground scene is accomplished by different techniques in the Earth Resources Technology Satellite (ERTS) Multi-Spectral Scanner (MSS) and Return Beam Vidicon (RBV) systems, the boundaries of an MSS image and RBV image will not be the same. The study discussed was intended to define the image boundaries and the changes in these boundaries due to variations in the position and orientation of the ERTS spacecraft. Quantitative results are derived for the nominal case with perfect attitude control and for expected worst case effects of attitude variations. Author

N71-37946* Allied Research Associates, Inc., Concord, Mass. Geophysics and Aerospace Div.

ERTS: A PHOTOGRAPHIC DATA MANAGEMENT CONCEPT, VOLUME 3

Walter C. Ahlin, Earl S. Merritt, and John E. Sissala Jan. 1971 166 p refs 3 Vol.

(Contract NAS5-10343)

(NASA-CR-121980; TR-16-Vol-3; ARA-9G45-70-77-Vol-3) Avail: NTIS CSCL 14B

Earth Resources Technology Satellite (ERTS) data rates and time lines are combined with user requirements to derive a development plan for implementation and operation of a supporting photographic data processing, management, and dissemination system. The plan specifies requirements for and phasing of facilities, equipment, personnel and operating procedures. Author

N71-38013* South Dakota School of Mines and Technology, Rapid City. Inst. of Atmospheric Sciences.

COMPARISON OF INFORMATION CONTENT OF SPACE PHOTOGRAPHY AND LOW ALTITUDE AERIAL PHOTOGRAPHY Final Report

Lewis H. Shapiro Jun. 1971 47 p refs

(Contract Di-14-08-001-12682)

(IR-USGS-229; USGS-DO-71-012) Avail: NTIS

Three problems are discussed. First it is shown, through the use of information theory, that the capability of space photography to transmit information compares favorably to that of conventional aerial photography. Secondly, results indicate that there is a significant overlap between the size of the smallest features which can be identified on the space photography and the larger features which can be identified on low altitude photography at scales of less than 1:15,000. Last is the determination of the geologic information content of space and conventional aerial photography. Author

N72-12255* Office of Emergency Preparedness, Washington, D.C.

EXPERIMENTAL APPLICATIONS OF MULTISPECTRAL DATA TO NATURAL RESOURCE INVENTORY AND SURVEY

Harry J. Mallon In NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 33 p refs

Avail: NTIS CSCL 08G

The feasibility of using multispectral, color, color infrared, thermal infrared imagery and related ground data to recognize, identify, determine and monitor the status of mineral ore and metals stockpiles is studied. An attempt was made to identify valid, unique spectral signatures of such materials for possible use under a wide variety of environmental circumstances. Research emphasis was upon the analysis of the multiband imagery from the various film-filter combinations, using density analysis techniques. Author

N72-12261* Geological Survey, Denver, Colo.

A THERMAL MODEL FOR ANALYSIS OF INFRARED IMAGES

Kenneth Watson In NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 16 p refs

Avail: NTIS CSCL 12A

A mathematical model derived from the equation of heat conduction was developed to assist in interpreting thermal infrared images acquired from aircraft and spacecraft. The model assumes steady state boundary conditions. It contains parameters of rock and soil properties, atmospheric effects, site location, and season. The results predicted provide an explanation for the thermal differences among granite, limestone, and dolomite recorded in the December 1968 daytime and predawn flights over the Mill Creek, Oklahoma test site, during which representative thermal inertia and albedo values were used. A second test of the model made use of data acquired during the June 1970 predawn overflight of Mill Creek. A simple model of transient heating of the ground was constructed as an extension of the overall model, in order to examine the effects of atmospheric perturbations. The results obtained are consistent with those of ground observations made at the time of the overflight. Author

N72-12277* Agricultural Research Service, Weslaco, Tex. Soil and Water Conservation Research Div.

COMPUTER DISCRIMINATION PROCEDURES APPLICABLE TO AERIAL AND ERTS MULTISPECTRAL DATA

Arthur J. Richardson, Robert J. Torline, and William A. Allen In NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 24 p refs

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 02C

Two statistical models are compared in the classification of crops recorded on color aerial photographs. A theory of error ellipses is applied to the pattern recognition problem. An elliptical boundary condition classification model (EBC), useful for recognition of candidate patterns, evolves out of error ellipse theory. The EBC model is compared with the minimum distance to the mean (MDM) classification model in terms of pattern

recognition ability. The pattern recognition results of both models are interpreted graphically using scatter diagrams to represent measurement space. Measurement space, for this report, is determined by optical density measurements collected from Kodak Ektachrome Infrared Aero Film 8443 (EIR). The EBC model is shown to be a significant improvement over the MDM model. Author

N72-12287* Michigan Univ., Ann Arbor. Willow Run Labs.
USER ORIENTED DATA PROCESSING AT THE UNIVERSITY OF MICHIGAN c08
Frederick J. Thomson /in NASA. Manned Spacecraft Center
3d Ann. Earth Resources Program Rev., Vol. 2 1970 18 p refs
Avail: NTIS HC \$9.00/MF \$0.95 CSCL 05B

The multispectral techniques have shown themselves capable of solving problems in a large number of user areas. The results obtained are in some instances quite impressive. In many instances, the multispectral detection of various phenomena is an empirical fact for which there is little physical explanation today. To date, most of the user applications that have been addressed are exploratory in nature. The closest approximation to an operational situation encountered so far is that of the survey of wetlands in North Dakota reported in this paper. Author

N72-12288* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
THE APPLICATION OF AUTOMATIC RECOGNITION TECHNIQUES IN THE APOLLO 9 SO-65 EXPERIMENT c14
R. B. MacDonald /in NASA. Manned Spacecraft Center
3d Ann. Earth Resources Program Rev., Vol. 2 1970 17 p

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 14E

A synoptic feature analysis is reported on Apollo 9 remote earth surface photographs that uses the methods of statistical pattern recognition to classify density points and clusterings in digital conversion of optical data. A computer derived geological map of a geological test site indicates that geological features of the range are separable, but that specific rock types are not identifiable. G.G.

N72-12289* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
THE DEVELOPMENT OF MACHINE TECHNOLOGY PROCESSING FOR EARTH RESOURCE SURVEY c14
D. A. Landgrebe /in NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 31 p refs

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 14E

The following technologies are considered for automatic processing of earth resources data: (1) registration of multispectral and multitemporal images, (2) digital image display systems, (3) data system parameter effects on satellite remote sensing systems, and (4) data compression techniques based on spectral redundancy. The importance of proper spectral band and compression algorithm selections is pointed out. G.G.

N72-12292* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
INTERACTIVE DISPLAY/GRAPHICS SYSTEMS FOR REMOTE SENSOR DATA ANALYSIS c07
W. G. Eppler, D. L. Loe, E. L. Wilson, S. L. Whitley, and R. J. Sachse /in Its 3d Ann. Earth Resources Program Rev., Vol. 2 1970 p 19 refs Prepared in cooperation with Lockheed Electronics Co., Houston, Tex.

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 17B

A color-television display system and interactive graphics equipment on-line to an IBM 360/44 computer are used to develop a variety of interactive displays which aid in analyzing remote sensor data. These interactive displays are used to: (1) analyze data from a multispectral scanner; (2) develop automatic

pattern recognition systems based on multispectral scanner measurements; and (3) analyze data from non-imaging sensors such as the infrared radiometer and microwave scatterometer.

Author

N72-12293* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex. Earth Observation Div.
RESULTS OF SCATTEROMETER SYSTEMS ANALYSIS FOR NASA/MSC EARTH OBSERVATION SENSOR EVALUATION PROGRAM c14
K. Krishen, N. Vlahos, O. Brandt, and G. Graybeal /in Its 3d Ann. Earth Resources Program Rev., Vol. 2 1970 50 p refs Prepared in cooperation with Lockheed Electronics Co., Houston, Tex.

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 14B

A systems evaluation of the 13.3 GHz scatterometer system is presented. The effects of phase error between the scatterometer channels, antenna pattern deviations, aircraft attitude deviations, environmental changes, and other related factors such as processing errors, system repeatability, and propeller modulation, are established. Furthermore, the reduction in system errors and calibration improvement is investigated by taking into account these parameter deviations. Typical scatterometer data samples are presented. Author

N72-12294* Lockheed Electronics Co., Houston, Tex. Aerospace Systems Div.
PHENOMENOLOGICAL APPROACH TO SCATTEROMETER DATA INTERPRETATION c08
F. E. Alzofon /in NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 8 p refs

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 05B

A graphic method of analyzing radar scatterometer sea clutter data leading to linear relations between scattering cross sections and tan angle of incidence of the radiation is proposed. This relation permits formulation of simple analytic relations without reference to the ocean surface spectrum. Parameters introduced depend on the wavelength of the incident radiation and its polarization, and on wind and sea states. The simplicity of the expressions derived suggests a corresponding simplicity in the physical mechanism of radar sea clutter return. Author

N72-12303* Geological Survey, St. Louis, Mo.
DATA RELAY SYSTEM SPECIFICATIONS FOR ERTS IMAGE INTERPRETATION
James F. Daniel /in NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 3 1970 8 p refs

Avail: NTIS HC \$6.00/MF \$0.95 CSCL 14E

Experiments with the Data Collection System (DCS) of the Earth Resources Technology Satellites (ERTS) have been developed to stress ERTS applications in the Earth Resources Observation Systems (EROS) Program. Active pursuit of this policy has resulted in the design of eight specific experiments requiring a total of 98 DCS ground-data platforms. Of these, eight experiments, six are intended to make use of DCS data as an aid in image interpretation, while two make use of the capability to relay data from remote locations. Preliminary discussions regarding additional experiments indicate a need for at least 150 DCS platforms within the EROS Program for ERTS experimentation. Results from the experiments will be used to assess the DCS suitability for satellites providing on-line, real-time, data relay capability. The rationale of the total DCS network of ground platforms and the relationship of each experiment to that rationale are discussed. Author

N72-18111# Kansas Univ., Lawrence. Dept. of Geography.
AN ANALYSIS OF MULTISPECTRAL IMAGERY FOR TROPICAL LAND USE DISCRIMINATION c13
Roland D. Mower /in AGARD Propagation Limitations in Remote Sensing Oct. 1971 16 p refs

07 DATA PROCESSING AND DISTRIBUTION SYSTEMS

(Contract DI-14-08-0001-12077)

Avail: NTIS HC \$6.00/MF \$0.95

Imagery data from a number of flight lines over Puerto Rico were analyzed to determine to what extent selected land use classes could be discriminated using conventional image interpretation techniques. The results were then compared with those obtained through use of a semi-automated densitometer/computer process. The semi-automated technique was also employed to determine which of the nine imagery channels (Ektachrome blue, green, red, and IR; multiband blue, green, red, and IR; and IR scanner) provides the best discrimination for each of the land use classes considered. A number of tentative conclusions were made regarding the relative performance of the imagery channels tested. Author

N72-16139# General Motors Corp., Goleta, Calif. Delco Electronics Div.

REMOTE AUTOMATIC MULTIPURPOSE STATION Quarterly Report

Oct. 1971 19 p refs

(Contract N00014-71-C-0357; ARPA Order 1783; NR Proj. 307-340)

(AD-732022; TR-1) Avail: NTIS CSCL 09/6

The report describes the Remote Automatic Multipurpose Station (RAMS) which was established to provide remote sensing of oceanographic and meteorological data in the Arctic regions. GRA

N72-16144*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

A UNIVAC 1108 COMPUTER PROGRAM FOR USE WITH WORLDWIDE CLOUD COVER DISTRIBUTION DATA

Kirby D. Kyle Oct. 1971 35 p ref

(NASA-TM-X-58071) Avail: NTIS CSCL 09B

A computer program which implements the use of worldwide cloud-cover distribution data is discussed. This program was prepared for use on the NASA Manned Spacecraft Center Univac 1108 computer. Author

N72-17184*# Radiation, Inc., Melbourne, Fla. Systems Engineering Dept.

ERTS DIRECT READOUT GROUND STATION STUDY Final Report

Dec. 1971 241 p refs

(Contract NAS5-21622)

(NASA-CR-122343; Rept-7840-72-001) Avail: NTIS CSCL 14B

A system configuration which provides for a wide variety of user requirements is described. Two distinct user types are considered and optimized configurations are provided. Independent satellite transmission systems allow simultaneous signal transmission to Regional Collection Centers via a high data rate channel and to local users who require near real time consumption of lower rate data. In order to maximize the ultimate utility of this study effort, a parametric system description is given such that in essence a shopping list is provided. To achieve these results, it was necessary to consider all technical disciplines associated with high resolution satellite imaging systems including signal processing, modulation and coding, recording, and display techniques. A total systems study was performed. Author

N72-17234 Tennessee Univ., Knoxville.
WAVEFORM AND COMPUTER ANALYSIS OF GEOGRAPHIC PATTERNS RECORDED ON COLOR AND COLOR INFRARED PHOTOGRAPHY FROM AERIAL AND ORBITAL ALTITUDES Ph.D. Thesis

Graydon Lennis Berlin 1970 166 p

Avail: Univ. Microfilms Order No. 70-20295

A black and white television system successfully translated pictorial or iconic forms of color and color infrared photography to the analytic. The instrumentation system enabled a video conversion of land use or land type occurrences to graytone percentages, with a certain range of percentages representing a

specific type. Colors were successfully converted to identifiable graytones from photos made at 5,000 feet, 15,000 feet, and from orbital altitudes exceeding 100 miles. With geographic patterns in digital form, a computer program was developed to process the waveform analysis of imagery. An orbital photo of the lower Nile Valley was digitized, and the computer accomplished the following tasks: (1) transformed graytone percentages to letter equivalents, (2) mapped graytone distributions, and (3) estimated the area of each graytone distribution. Additional discussion noted equipment additions that could be incorporated into the television system to more fully automate computer inputs. Dissertation.

N72-17311# Iowa State Water Resources Research Inst., Ames.

REMOTE DETECTION OF MOISTURE STRESS: FIELD AND LABORATORY EXPERIMENTS

Richard Eugene Carlson Jun. 1971 108 p refs

(Contract DI-14-31-0001-3015; OWRR Proj. A-031-IA(5))

(PB-202823; ISWRIR-37; W71-12582) Avail: NTIS CSCL 02D

The wavelength region examined was from 800 to 2,600 millimicrons. Leaf reflectivity and leaf adsorptivity were highly correlated with relative leaf water content. The relationship between leaf transmissivity and relative leaf water content was variable with wavelength. Leaf transmissivity was, however, highly correlated with leaf specific densities. The data indicated that a field reflectometer could be constructed and possibly used to monitor leaf water status. In field experiments leaf temperature was significantly affected by relative leaf water content, air temperature, and vapor pressure deficit. Air temperature affected leaf temperature by modifying stomatal conductivities and hence, the leaf transpiration rate. The leaf temperatures of the two soybean varieties were different, dependent upon the dryness of the air. Author(NSA)

N72-17320# Geological Survey, Denver, Colo.

A COMPUTER PROGRAM OF THERMAL MODELING FOR INTERPRETATION OF INFRARED IMAGES

Kenneth Watson 1971 33 p

(PB-203578; USGS-GD-71-023) Avail: NTIS CSCL 08G

An equation for the surface temperature resulting from steady periodic heating of a one-dimensional homogeneous half space is used to model the diurnal surface-temperature variation of the ground for different ground properties, sky properties, and the site latitude and season. Author (GRA)

N72-17570# Israel Program for Scientific Translations, Ltd., Jerusalem.

USE OF METEOROLOGICAL-SATELLITE DATA AS A NAVIGATION AID

K. P. Vasilev In: *its* Probl. of Satellite Meteorol. 1970 p 48-57 refs

Avail: NTIS

The use of satellite data as a navigation aid is considered, and methods for interpreting satellite television pictures of sea ice are described. The significance of climatic data in interpreting satellite photographs and the establishment of ice charts from satellite photographs are discussed. An example is presented of supplying ice information, obtained from satellite data, to a survey vessel. The problem of selecting photographs of cloud vortices to determine zones of gale-force swells in the ocean as a function of the cyclone development stage is considered in detail. Author

N72-18195*# South Dakota State Univ., Brookings. Remote Sensing Inst.

PATTERN RECOGNITION SYSTEMS AND PROCEDURES Annual Report

Gerald D. Nelson and David V. Serreyn Feb. 1972 23 p refs

(Grant NGL-42-003-007)

(RSI-72-03; NASA-CR-125668) Avail: NTIS CSCL 05B

The objectives of the pattern recognition tasks are to

develop (1) a man-machine interactive data processing system; and (2) procedures to determine effective features as a function of time for crops and soils. The signal analysis and dissemination equipment, SADE, is being developed as a man-machine interactive data processing system. SADE will provide imagery and multi-channel analog tape inputs for digitization and a color display of the data. SADE is an essential tool to aid in the investigation to determine useful features as a function of time for crops and soils. Four related studies are: (1) reliability of the multivariate Gaussian assumption; (2) usefulness of transforming features with regard to the classifier probability of error; (3) advantage of selecting quantizer parameters to minimize the classifier probability of error; and (4) advantage of using contextual data. The study of transformation of variables (features), especially those experimental studies which can be completed with the SADE system, will be done. Author

N72-18199* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

DATA ACQUISITION SYSTEM FOR OPERATIONAL EARTH OBSERVATION MISSIONS

J. M. Deerwester, D. Alexander, R. D. Arno, L. E. Edsinger, S. M. Norman, K. F. Sinclair, E. L. Tindle, and R. D. Wood Washington Feb. 1972 253 p refs
(NASA-TM-X-62107) Avail: NTIS CSCL 05B

The data acquisition system capabilities expected to be available in the 1980 time period as part of operational Earth observation missions are identified. By data acquisition system is meant the sensor platform (spacecraft or aircraft), the sensors themselves and the communication system. Future capabilities and support requirements are projected for the following sensors: film camera, return beam vidicon, multispectral scanner, infrared scanner, infrared radiometer, microwave scanner, microwave radiometer, coherent side-looking radar, and scatterometer. Author

N72-18349* Toronto Univ. (Ontario). Dept. of Geography.
COHERENT OPTICAL DATA PROCESSING AND REMOTELY SENSED IMAGERY

E. Bruce MacDougall May 1969 66 p refs
(NASA Order R-09-020-024; Contract DI-14-08-0001-11259)
(NASA-CR-125640; USGAS-IR-NSA -145) Avail: NTIS CSCL 08G

It is shown that an automatic imaging system consisting of a combination of optical and digital computer elements is feasible and has considerable advantages over direct image scanning systems. With such a system, it is possible to process very large quantities of remotely sensed image spectra. Author

N72-20351* California Univ., Davis. Dept. of Electrical Engineering and Computer Sciences.

DIGITAL HANDLING AND PROCESSING OF REMOTE SENSING DATA

R. Algazi and D. Akrison *In its* An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Tech. 1 Jan. 1972 25 p
Avail: NTIS HC \$6.00/MF \$0.95 CSCL 08G

Progress is reported on work done on the digital handling and processing of remote sensing data, and more specifically as it refers to electronic image enhancement. Discussed in detail are: (1) detailed specification of plans for the digital processing facility which is the heart of present and current research; (2) assembly and construction of the digital image processing facility; (3) work on means and programs for data acquisition and handling, and developing a system for use in programming various digital image processing tasks; and (4) development digital signal processing algorithms of broad relevance to feature enhancement of remote sensing data. A.L.

N72-20352* California Univ., Davis. Dept. of Agricultural Engineering.

INVESTIGATION OF ATMOSPHERIC EFFECTS IN IMAGE

TRANSFER

K. L. Coulson and R. L. Walraven *In its* An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Devices 1 Jan. 1972 16 p Original contains color illustrations

Avail: NTIS HC \$6.00/MF \$0.95 CSCL 14B

A dual channel polarizing radiometer has been built for measuring the intensity and polarization parameters of incident light rapidly with high precision. The instrument uses the photon counting technique to measure intensity. A computer program has been written for computing the effects of dust, haze, and other aerosol particles on the field of radiation emerging from the top of the atmosphere. By the use of atmospheric models, it will be possible to study the sensitivity of the radiation field to parameters such as the size-frequency distribution of aerosol particles, real and complex parts of the index of refraction, and the vertical profile of the aerosol concentrations. Photographs have been taken with polarizing optics to obtain a preliminary estimate of the advantage to be gained by the use of polarization for enhancing the transfer of images from surface to high altitude sensor in the actual atmosphere. A.L.

N72-22130* Allied Research Associates, Inc., Baltimore, Md.
WEAKLY STATIONARY NOISE FILTERING OF SATELLITE-ACQUIRED IMAGERY

J. J. O. Palgen, I. Tamches, and E. S. Deutsch Dec. 1971 40 p refs
(Contract NAS5-21617)
(NASA-CR-122381; Rept-9G90-11; TR-3) Avail: NTIS CSCL 20F

A type of weakly stationary noise called herringbone noise was observed in satellite imagery. The characteristics of this noise are described; a model for its simulation was developed. The model is used to degrade pictorial data for comparison with similar noise degraded Nimbus data. Two filtering methods are defined and evaluated. A user's application demonstration is discussed. Author

N72-22366* Stanford Univ., Calif. Remote Sensing Lab.
THE 1970/71 SPECTRAL DATA MANAGEMENT PROGRAMS Final Report (A), phase 4: Software (computer programming)

A. A. Marshall Jun. 1971 60 p refs
(Contract NAS9-7313)
(NASA-CR-115522; SU-RSL-TR-71-2) Avail: NTIS CSCL 08G

The data management programs used by the Stanford Remote Sensing Laboratory to access, modify, and reduce the data obtained from both the NASA IR airborne spectrometer, and Stanford's SG-4 field spectrometer are reported. Many details covered in previous reports are not repeated. References are provided. These programs are written in FORTRAN 4 and S/360 Assembler Language, and are currently running on a S/360 model 67 (operating under OS/MFT) at the Stanford Computation Center Campus Facility. Author

N72-22367* Texas A&M Univ., College Station.
ANALYSIS OF SIMULATED MULTISPECTRAL DATA FROM EARTH RESOURCES SATELLITES

D. A. White, J. W. Rouse, Jr., and J. A. Scheel Sep. 1971 44 p refs Presented at the IEEE 3d Intern. Geosci. Electron. Symp., Washington, D. C., Sep. 1971
(Grant NGL-44-001-001)

(NASA-CR-126245; RSC-35) Avail: NTIS CSCL 08G

The validity of the applicability assumption was determined through the simulation of ERTS and Skylab data using available aircraft scanner systems. The research techniques compared aircraft multispectral scanner data obtained under nominal conditions at low altitudes. Maximum likelihood decision criteria algorithms implemented on a digital computer were used to classify training set data. Comparisons between percentages of correct classifications were made, along with implications as to the techniques of satellite analysis. Author

07 DATA PROCESSING AND DISTRIBUTION SYSTEMS

N72-23288 International Business Machines Corp., Gaithersburg, Md. Federal Systems Div.

GROUND DATA PROCESSING CONSIDERATIONS FOR EARTH RESOURCE INFORMATION

Leonard E. Mumbower /In Princeton Univ. Proc. of the Princeton Univ. Conf. on Aerospace Methods for Revealing and Evaluating Earth's Resources 4 May 1972 28 p

Copyright. Avail: Issuing Activity

Most of the data from remote sensors mounted on aerospace platforms will be in image formats, and system techniques for processing this data are discussed. These techniques include collection control, image processing, storage and retrieval, data extraction, and user application. The concepts are based on the successful implementation of similar systems during the past several years and on the results of investigations which have analyzed the objectives and requirements for handling earth resource information. Most critical will be the area of data extraction. With all information in digital form, it is possible to improve the ability of the system to provide information tailored to the needs of the user and in a format for direct application to his area of interest. Author

N72-23289 Radio Corp. of America, Hightstown, N.J. Ground Data Handling Systems.

USER DATA PROCESSING REQUIREMENTS

Herbert Gurk /In Princeton Univ. Proc. of the Princeton Univ. Conf. on Aerospace Methods for Revealing and Evaluating Earth's Resources Jun. 1970 15 p

Copyright. Avail: Issuing Activity

Processing techniques which are common to many users and special processing techniques are discussed, with emphasis on the latter. Special processing is illustrated with applications to use of ERTS data by the Tennessee Valley Authority and the Desert Research Institute. The major applications are forest inventory for the TVA and playa lake inventory for the DRI: land reclamation is also a major concern. Potential special processing techniques are identified as automatic analysis, interpretation aids, and data management. The requirements of partitioning, mosaicking, and presenting information at 1:250,000 scale of a smaller area are also discussed. N.E.N.

N72-23320# Science Advisor to the President, Washington, D.C.

DATA HANDLING

Edward E. David, Jr. /In Comm. on Sci. and Astronaut. (U.S. House) Remote Sensing of Earth Resources 1972 p 169-173

Avail: SOD \$1.25

Data handling processes and their application to data received from ERTS A and B are discussed. The factors which must be considered in designing an effective data processing and management system are outlined. Particular emphasis is placed on selectivity in the collection and processing of data. It is pointed out that selectivity in examining pictures sent out by ERTS A could cut the job of photointerpretation by at least a factor of 10 and more likely a factor of 100 or 1000. D.L.G.

N72-23321# Sperry Rand Corp., Washington, D.C. Univac Div. SPACE COMMUNICATIONS

Carl Hammer /In Comm. on Sci. and Astronaut. (U.S. House) Remote Sensing of Earth Resources 1972 p 175-195

Avail: SOD \$1.25

The processes involved in the transformation of raw data collected in space into useful scientific information are discussed. These processes include: (1) data generation and acquisition, (2) data transmission and reception, (3) data conversion and filtering, and (4) presentation and use of information. In addition, electronic data handling systems are discussed in terms of basic ingredients, real time operation, engineering principles, and facilities management. D.L.G.

N72-23322# Control Data Corp., Minneapolis, Minn.

IMAGE PROCESSING OF REMOTE SENSOR DATA

Robert L. Lillestrand /In Comm. on Sci. and Astronaut. (U.S. House) Remote Sensing of Earth Resources 1972 p 197-208

Avail: SOD \$1.25

Problems associated with the processing of imagery after its arrival at the ground processing center are considered. One of the basic problems discussed is that of estimating the amount of data which will be derived from remote sensing. Other problems examined are those involved in the creation of a coordinate-rectified data base. The role of digital computers in solving many of these problems is discussed. D.L.G.

N72-24511# Kansas Univ., Lawrence, Center for Research.

TEXTURE-TONE STUDY WITH APPLICATION TO DIGITIZED IMAGERY Interim Technical Report, 1 Nov. 1970 - 1 Nov. 1971

Robert M. Haralick and Delmar E. Anderson Nov. 1971 154 p refs

(Contract DAAK02-70-C-0388; DA Proj. 4A0-62112-A-854)

(AD-737722; CRES-TR-182-2; ETL-CR-71-14) Avail: NTIS CSCL 14/5

An image data set of 54 scenes was obtained from 1/8 inch by 1/8 inch areas on a set of 1:20000 scale photography. The scenes, which consisted of 6 samples from each of the nine categories scrub, orchard, heavily wooded, urban, suburban, lake, swamp, marsh, and railroad yard, were analyzed manually and automatically. For the automatic analysis, a set of features measuring the spatial dependence of the grey tones of neighboring resolution cells was defined. On the basis of these features and a simple decision rule, which assumed that the features were independent and uniformly distributed, an identification accuracy of 70% was achieved by training on 53 samples and assigning an identification to the 54th sample and repeating the experiment 54 times. Author (GRA)

N72-27204*# Northrop Services, Inc., Huntsville, Ala.

UNSUPERVISED CLASSIFICATION OF REMOTE MULTI-SPECTRAL SENSING DATA

M. Y. Su 15 Apr. 1972 102 p refs

(Contract NAS8-27364)

(NASA CR-123799; TR-220-1075) Avail: NTIS HC \$7.25 CSCL 09D

The new unsupervised classification technique for classifying multispectral remote sensing data which can be either from the multispectral scanner or digitized color-separation aerial photographs consists of two parts: (a) a sequential statistical clustering which is a one-pass sequential variance analysis and (b) a generalized K-means clustering. In this composite clustering technique, the output of (a) is a set of initial clusters which are input to (b) for further improvement by an iterative scheme. Applications of the technique using an IBM-7094 computer on multispectral data sets over Purdue's Flight Line C-1 and the Yellowstone National Park test site have been accomplished. Comparisons between the classification maps by the unsupervised technique and the supervised maximum likelihood technique indicate that the classification accuracies are in agreement. Author

N72-28319*# Itek Corp., Lexington, Mass. Optical Systems Div.

AUTOMATED THEMATIC MAPPING AND CHANGE DETECTION OF ERTS-A IMAGES Progress Report, 6 Jun. - 15 Jul. 1972

Nicholas Gramenopoulos, principal investigator 24 Jul. 1972 1 p

(Contract NAS5-21768)

(E72-10013; NASA-CR-127616; GSFC-ID-PR504;

ERTS-A-Proposal-MMC-074) Avail: NTIS HC \$3.00 CSCL 08B Author

N72-28328* Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.

THE DEVELOPMENT OF AN EARTH RESOURCES INFORMATION SYSTEM USING AERIAL PHOTOGRAPHS AND DIGITAL COMPUTERS Annual Progress Report

Elliot L. Amidon, David A. Sharpnack, and Robert M. Russell
30 Sep. 1971 10 p refs

(NASA Order R-09-038-002)

(NASA-CR-127690) Avail: NTIS HC \$3.00 CSCL 08G

Analytical photogrammetry demonstrated that automatic three dimensional mapping of forest terrain was technically feasible. The examples were black and white photography at scales of 1:10,000 and 1:24,000. The major improvement in terrain modelling was the addition of the capability of joining small quadrangles together to form one large model about equal to the effective area of the pair of photographs. Improvements of somewhat lesser importance include: (1) the use of up to 16 grey levels; (2) the elimination of several coordinate transformations; and (3) the annotation of three-tone hysocline maps with elevations.

Author

N72-28334* Biospherics, Inc., Rockville, Md.

AIRBORNE MICROWAVE RADIOMETRIC DATA ANALYSIS, PART 2 Final Report

13 Jun. 1972 62 p

(Contract NAS5-21674)

(NASA-CR-122444) Avail: NTIS HC \$5.25 CSCL 08G

Between 6 March and 13 March 1972, NASA conducted a series of remote sensing experiments over the Imperial Valley, California and Phoenix, Arizona. NASA personnel employed the use of a Convair 990 fitted with microwave radiometers and photographic equipment in several overflights of the area. Ground-based operations, which included the coordination of sampling teams, placement of flight line markers, soil sample collection, soil moisture analysis, field observations, photography and data handling, are discussed.

Author

N72-28363* National Research Council of Canada, Ottawa (Ontario).

PHOTOGRAMMETRIC ASPECTS OF PRECISION PROCESSING OF ERTS-A IMAGERY

Vladimir Kratky [1971] 36 p refs

Avail: NTIS HC \$4.00

The ERTS-A imagery as formed aboard the satellite by the return beam vidicon (RBV) camera and multispectral scanning system (MSS), radio transmitted to earth and displayed by special reproducers, will be considerably distorted due to several factors. The character of the distortion depends mainly on the geometric properties of the imaging system and on the dynamic flight conditions. The RBV geometry is analyzed with attention to electronic distortion. Appropriate analytical formulation based on polynomial and projective transformation is shown to be capable of providing line modulation control. The geometry of MSS images is discussed in detail with respect to the distorting effects of earth rotation and the applied cartographic projection. The combined effect of these factors is assessed by means of expected errors and illustrated by several tables.

Author

N72-28374* Toronto Univ. (Ontario). Faculty of Forestry.
CONSIDERATIONS IN DETERMINATION, EVALUATION AND COMPUTER BANKING OF SPECTRAL SIGNATURES OF NATURAL OBJECTS

J. Vitek Mar. 1972 31 p refs Sponsored by Forest Management Inst.

(FMR-22) Avail: NTIS HC \$3.75 CSCL 02F

The most important spectral property in applications of remote sensing is the reflectance of radiant energy from natural objects. Reflectance is the ratio of reflected to incident radiation, usually expressed as a percentage. Discussed is the theory of reflectance, its measurement, its characteristics in vegetation, its statistical nature, and the outline of a data bank approach to reflectance data storage and retrieval.

Author

N72-28392 Institut Francais du Petrole, Paris (France).

POSSIBILITIES OF DIGITAL IMAGING TECHNIQUES AND SURFACE REPRESENTATION [QUELQUES POSSIBILITES DE TRAITEMENT NUMERIQUE ET DE REPRESENTATION DE SURFACE]

A. Fontanel and C. Hemon /In CNES Remote Sensing of Earth Resources Oct. 1971 p 246-275 refs In FRENCH; ENGLISH summary

Various types of digital techniques used to process remote sensing recordings are described. They include: deconvolution to improve resolution; and directional filtering to eliminate (or enhance) a previously chosen range of directions. An example is given which shows how contour can be automatically determined from a seismic recording. Possibilities of multispectral recording are considered, and an example is given of side-scanning sonar image data compression. Some examples of computer printout are given.

ESRO

N72-28393 Ecole Nationale Supérieure du Petrole et des Monteurs, Rueil-Malmaison (France).

OPTICAL PROCESSING OF THERMOGRAPHS [TRAITEMENT OPTIQUE DES THERMOGRAPHIES]

P. Boissard /In CNES Remote Sensing of Earth Resources Oct. 1971 p 276-306 refs In FRENCH

Aerial thermographs of the Minervois de l'Herault terrain done during summer 1970 are interpreted. Spatial filtering was applied to the thermographs. The optical density of the pictures was studied by an isodensitometric method. A method for correcting the picture deformations is presented. The advantages of this optical processing method and its application to the processing of aerial images recorded by other techniques are stressed.

ESRO

N72-28394 Ecole Nationale Supérieure du Petrole et des Monteurs, Rueil-Malmaison (France).

INTERPRETATION OF MINERVOIS DE L'HERAULT THERMOGRAPHS [INTERPRETATION DES THERMOGRAPHES DU MINERVOIS DE L'HERAULT]

C. Torres /In CNES Remote Sensing of Earth Resources Oct. 1971 p 307-341 In FRENCH

Results obtained from aerial thermographs of the Minervois l'Herault terrain are compared with results from aerial photographs of the same site using four photographic emulsions and interpreted using ground based terrain verifications. The advantages of using remote thermographs are demonstrated. It is concluded that both remote thermography and aerial photography are required for soil mapping and terrain analysis.

ESRO

N72-28396 Strasbourg Univ. (France). Centre de Geographie Appliquee.

INTEGRATED STUDY OF THE ECOLOGICAL MILIEU USING REMOTE SENSING IMAGES [L'ETUDE INTEGREE DU MILIEU ECOLOGIQUE AU MOYEN D'IMAGES DE TELEDETECTION]

J. Tricart and G. J. Lutz /In CNES Remote Sensing of Earth Resources Oct. 1971 p 356-376 In FRENCH

Results obtained from remote sensing of the Saint-Pons site are summarized, and the methodology for interpretation of data is presented. It includes object identification of the images followed by ground based data correlation with remote sensing data from infrared imagery and thermographic measurements. Results on the lithology, hydrology, and vegetation cover are reported.

ESRO

N72-28634* Earth Satellite Corp., Washington, D.C.

FACILITATING THE EXPLOITATION OF ERTS-IMAGERY USING SNOW ENHANCEMENT TECHNIQUES Monthly

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Progress Report

Frank J. Wobber, principal investigator 7 Jul. 1972 5 p
Sponsored by NASA
(E72-10007; NASA-CR-127551; GSFC-ID-sr141;
ERTS-A-Proposal-SR-141) Avail: NTIS HC \$3.00 CSCL 04B
Author

N72-29293*# Boeing Co., Seattle, Wash. Computer Services.
NATURAL RESOURCE INFORMATION SYSTEM. REMOTE SENSING STUDIES Final Report
J. Leachtenauer, R. Hirsch, V. Williams, and R. Tucker May 1972 116 p Sponsored by Bur. of Indian Affairs, Earth Resources Observation Systems program, and NASA (NASA-CR-127809; USGS-DO-72-015) Avail: NTIS HC \$8.00 CSCL 02F

Potential applications of remote sensing data were reviewed, and available imagery was interpreted to provide input to a demonstration data base. A literature review was conducted to determine the types and qualities of imagery required to satisfy identified data needs. Ektachrome imagery available over the demonstration areas was reviewed to establish the feasibility of interpreting cultural features, range condition, and timber type. Using the same imagery, a land use map was prepared for the demonstration area. The feasibility of identifying commercial timber areas using a density slicing technique was tested on multispectral imagery available for a portion of the demonstration area. Author

N72-29294*# Boeing Co., Seattle, Wash. Computer Services.
NATURAL RESOURCE INFORMATION SYSTEM. DESIGN ANALYSIS Final Report
May 1972 31 p refs Sponsored by Bur. of Indian Affairs, Earth Resources Observation Systems program, and NASA (NASA-CR-127810; USGS-DO-72-014) Avail: NTIS HC \$3.75 CSCL 08G

The computer-based system stores, processes, and displays map data relating to natural resources. The system was designed on the basis of requirements established in a user survey and an analysis of decision flow. The design analysis effort is described, and the rationale behind major design decisions, including map processing, cell vs. polygon, choice of classification systems, mapping accuracy, system hardware, and software language is summarized. Author

N72-29295*# Boeing Co., Seattle, Wash. Computer Services.
NATURAL RESOURCE INFORMATION SYSTEM. VOLUME 1: OVERALL DESCRIPTION
Apr. 1972 58 p refs Sponsored jointly by NASA, Bur. of Indian Affairs, and Earth Resources Observation Systems program Prepared for Bur. of Indian Affairs and Bur. of Land Management, Dept. of Interior (Contract K51C14200459) (NASA-CR-127812; USGS-DO-72-012-Vol-1) Avail: NTIS HC \$5.00 CSCL 08G

A prototype computer-based Natural Resource Information System was designed which could store, process, and display data of maximum usefulness to land management decision making. The system includes graphic input and display, the use of remote sensing as a data source, and it is useful at multiple management levels. A survey established current decision making processes and functions, information requirements, and data collection and processing procedures. The applications of remote sensing data and processing requirements were established. Processing software was constructed and a data base established using high-altitude imagery and map coverage of selected areas of SE Arizona. Finally a demonstration of system processing functions was conducted utilizing material from the data base. Author

N72-29296*# Boeing Co., Seattle, Wash. Computer Services.
NATURAL RESOURCE INFORMATION SYSTEM. VOLUME 2: SYSTEM OPERATING PROCEDURES AND INSTRUCTIONS Final Report

Apr. 1972 57 p refs Sponsored by NASA, Bur. of Indian Affairs, Earth Resources Observation Systems program Prepared for Bur. of Indian Affairs and Bur. of Land Management, Dept. of Interior (NASA-CR-127811; USGS-DO-72-013-Vol-2) Avail: NTIS HC \$5.00 CSCL 08G

A total computer software system description is provided for the prototype Natural Resource Information System designed to store, process, and display data of maximum usefulness to land management decision making. Program modules are described, as are the computer file design, file updating methods, digitizing process, and paper tape conversion to magnetic tape. Operating instructions for the system, data output, printed output, and graphic output are also discussed. Author

N72-29308* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ANALYSIS OF MULTISPECTRAL IMAGES SIMULATING ERTS OBSERVATIONS c14
Nicholas M. Short and Norman H. MacLeod In its 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 28 p Original contains color illustrations

CSCL 14E

Simulation studies of selected aircraft and spacecraft acquired images were initiated in response to anticipated desires of the user community for simulated imagery prior to launch of ERTS-A. Principal modes of simulation included: (1) areas of coverage comparable to ERTS; (2) spatial resolutions within these images similar to ERTS; (3) spectral responses analogous to that expected from each channel on both the return beam vidicon and multispectral scanner, leading to production of photographic images that should appear similar to those representing each band in the two sensors; and (4) runthroughs of several analytical techniques, such as color density slicing, color additive viewing, and computer-generated reflectance and surface temperature maps, by which ERTS data can be analyzed, interpreted, and applied. The two areas involved in the simulation study were Wyoming and the Chesapeake Bay region. A.L.

N72-29316* National Aeronautics and Space Administration. Mississippi Test Facility, Bay Saint Louis.
SUMMARY OF 1971 PATTERN RECOGNITION PROGRAM DEVELOPMENT
Sidney Lanier Whitley In its 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 33 p

CSCL 09B

Eight areas related to pattern recognition analysis at the Earth Resources Laboratory are discussed: (1) background; (2) Earth Resources Laboratory goals; (3) software problems/limitations; (4) operational problems/limitations; (5) immediate future capabilities; (6) Earth Resources Laboratory data analysis system; (7) general program needs and recommendations; and (8) schedule and milestones. Author

N72-29323* Lockheed Electronics Co., Houston, Tex.
CONSTRUCTING AND MANIPULATING COLOR IMAGERY FROM DIGITAL DATA
J. E. Davis, C. A. Helmke, T. R. Keil, M. J. Arldt, and E. L. Wilson In NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 29 p Original contains color illustrations

CSCL 14E

The development of a multispectral scanner data analysis console is reported that incorporates a wideband tape unit, a teletypewriter, a digital computer, and color display as well as numeric display terminals. The device is able to digitize infrared scanner images and displays color differences according to signal differences between analog channels. G.G.

N72-29328* Michigan Univ., Ann Arbor. Willow Run Labs.
A SUMMARY OF MICHIGAN PROGRAM FOR EARTH RESOURCE INFORMATION SYSTEMS
 Jon D. Erickson /in NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 19 p refs
 CSCL 05B

A summary and guide to the development of earth resources information systems which employ multispectral remote sensing are reported. Major areas of activities center on improved throughput parallel processing systems, improved processing techniques, practical use of techniques in user applications, and improved sensors. Cost effectiveness considerations point to signature extension, parallel processing all-digital computers, and airborne multispectral imaging radar as some of the improvement technologies. G.G.

N72-29329* Michigan Univ., Ann Arbor. Willow Run Labs.
INFORMATION EXTRACTION TECHNIQUES FOR MULTI-SPECTRAL SCANNER DATA
 William A. Malila, Robert B. Crane, Wyman Richardson, and Robert E. Turner /in NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 33 p refs
 CSCL 05B

Multispectral data recognition and information extraction problems considered are: (1) signature extension for improved recognition processing over large areas; (2) choice of density functions for recognition decision rules; (3) channel selection for cost reduction; and (4) radiation balance mapping for interpretation of wide spectrum scanner data. The formulation of a simulation model and reprocessing of both aircraft and space data reduces scan angle variations and extends signatures from one altitude to another. Comparison of the usefulness of empirical density functions and that of Gaussian density functions for recognition processing establishes the advantages of normal assumption for individual fields in processing of multispectral scanner data. Also reported is a procedure for producing radiation balance maps from wide spectra by analyzing energy budgets of vegetation and other surface materials through partitioning net absorbed radiant energy and estimating incoming power density at both short and long wavelengths. G.G.

N72-29330* Michigan Univ., Ann Arbor.
USER ORIENTED MULTISPECTRAL DATA PROCESSING AT THE UNIVERSITY OF MICHIGAN
 Frederick J. Thomson /in NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 22 p refs Original contains color illustrations

(Rept-03165-100-S) CSCL 05B

The feasibility of solving practical multispectral data reduction problems by available processing techniques and the identification of areas for more technical development requirements are considered. Parameter mapping and ratio mapping techniques prove their usefulness in a corn blight watch experiment. A hybrid computer processing system is advocated for complete realization of aircraft and spacecraft sensor potentials. G.G.

N72-29332* Michigan Univ., Ann Arbor. Willow Run Labs.
CLASSIFICATION OF SPATIALLY UNRESOLVED OBJECTS

Richard F. Nalepka, Harold M. Horwitz, Peter D. Hyde, and James P. Morgenstern /in NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 13 p
 (Contract NAS9-9784)
 CSCL 14E

A proportion estimation technique for classification of multispectral scanner images is reported that uses data point averaging to extract and compute estimated proportions for a single average data point to classify spatial unresolved areas. Example extraction calculations of spectral signatures for bare soil, weeds, alfalfa, and barley prove quite accurate. G.G.

N72-29338* Kansas Univ./Center for Research, Inc., Lawrence. Remote Sensing Lab.
DATA PROCESSING AT THE UNIVERSITY OF KANSAS

Robert M. Haralick /in NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 33 p refs Original contains color illustrations

CSCL 09B

Two systems for processing remotely sensed image data have been discussed. The first system, IDECS, is a near real-time hardware system oriented towards processing multi-image data sets quickly and economically. The IDECS has convenient film input and color display output capabilities and implements simple kinds of decision rules. The second system, KANDIDATS, is a software system capable of performing many of the more sophisticated processing methods. Because of its monitor which handles all bookkeeping and its modular design, KANDIDATS easily allows the testing of new automatic processing techniques. After a new technique has been proven on KANDIDATS, it may be simplified and hard-wired in IDECS, thereby keeping the volume processing of remotely sensed data always up to the current state-of-the-art. Author

N72-29342* South Dakota State Univ., Brookings. Remote Sensing Inst.
PATTERN RECOGNITION SYSTEM AND PROCEDURES

Gerald D. Nelson and David V. Serreyn /in NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 21 p refs

CSCL 09B

The ratio transformation technique is used to determine effective features as function of time in remote multiple sensing of crops and soils. The selection of quantizer parameters for a two-class recognition problem under the criteria of minimizing the probability of errors is also discussed. Author

N72-29350* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

DATA PROCESSING 1: ADVANCEMENTS IN MACHINE ANALYSIS OF MULTISPECTRAL DATA

Philip H. Swain /in NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 13 p refs
 (Grant NGL-15-005-112)

CSCL 09B

Multispectral data processing procedures are outlined beginning with the data display process used to accomplish data editing and proceeding through clustering, feature selection criterion for error probability estimation, and sample clustering and sample classification. The effective utilization of large quantities of remote sensing data by formulating a three stage sampling model for evaluation of crop acreage estimates represents an improvement in determining the cost benefit relationship associated with remote sensing technology. G.G.

N72-29351* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

DATA PROCESSING 2: ADVANCEMENTS IN LARGE SCALE DATA PROCESSING SYSTEMS FOR REMOTE SENSING

David Landgrebe /in NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 31 p
 (Grant NGL-15-005-112)

CSCL 09B

The development of large scale data processing systems for remote sensing is studied by evaluating: (1) the suitability of several sensor types with regard to producing data required for multispectral machine analysis; (2) various types of data preprocessing necessary to prepare such data for analysis; and

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(3) transfer of machine processing techniques for earth resources data to user community. G.G.

N72-29420* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

THE 1971 CORN BLIGHT WATCH EXPERIMENT DATA PROCESSING, ANALYSIS, AND INTERPRETATION

Terry L. Phillips *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 20 p

CSSL 02C

The principle data acquisition centers are listed for the corn blight experiment. A data storage and retrieval system was established. The purpose of the system was to: (1) store data in organized library; (2) maintain a record of all data stored and reduced for future access; (3) report the data in simplest form to users; and (4) record data reduction results from photographic and multispectral scanner sensors. The procedures designed for handling the large amounts of data are also reviewed. J.A.M.

N72-29421* Michigan Univ., Ann Arbor. Willow Run Labs. DETAILED INTERPRETATION AND ANALYSIS OF SELECTED CORN BLIGHT WATCH DATA SETS

R. F. Nalepka, J. P. Morgenstern, and W. L. Brown *In* NASA. Manned Spacecraft Center 4th ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 26 p Original contains color illustrations

(Contract NAS9-9784)

CSSL 02C

A detailed interpretation and analysis of selected corn blight data set was undertaken in order to better define the present capabilities and limitations of agricultural remote multispectral sensing and automatic processing techniques and to establish the areas of investigation needing further attention in the development of operational survey systems. While the emphasis of this effort was directed toward the detection of various corn blight levels, problems related to the more general task of crop identification were also investigated. Since the analog recognition computer (SPARC) was fully committed to the more routine aspects of processing and since the detailed interpretation and analysis required more in the way of quantitative information, the CDC 1604 digital computer was employed. Author

N72-30305*# Army Cold Regions Research and Engineering Lab., Hanover, N.H.

ARCTIC AND SUBARCTIC ENVIRONMENTAL ANALYSES UTILIZING ERTS-A IMAGERY

Duwayne M. Anderson, Principal Investigator [1972] 4 p Proposed for presentation at 8th Intern. Symp. on Remote Sensing of the Environment, Ann Arbor, Mich., 2-6 Oct. 1972 Sponsored by NASA

(E72-10025; NASA-CR-127761) Avail: NTIS HC \$3.00 CSSL 08G

N72-30307*# TRW Systems Group, Redondo Beach, Calif. ERTS IMAGE DATA COMPRESSION TECHNIQUE EVALUATION Monthly Progress Report, period ending 1 Aug. 1972

Donald J. Spencer, Principal Investigator 8 Aug. 1972 1 p (Contract NAS5-21746)

(E72-10027; NASA-CR-127892; TRW-7132.1-03) Avail: NTIS HC \$3.00 CSSL 05B

N72-30345*# Michigan Univ., Ann Arbor. Infrared and Optics Lab.

THE NASA EARTH RESOURCES SPECTRAL INFORMATION SYSTEM: A DATA COMPILATION, FIRST SUPPLEMENT

V. Leeman [1972] 159 p refs

(Contract NAS9-9784)

(NASA-CR-115755; WRL-31650-69-T-Suppl-1) Avail: NTIS HC \$10.00 CSSL 08G

The NASA Earth Resources Spectral Information System and the information contained therein are described. It is intended to be used as a supplement to the NASA Earth Resources Spectral Information System: A Data Compilation, N72-28366. This supplement includes approximately 500 rock and mineral, 100 soil, and 30 vegetation bidirectional and directional reflectance, transmittance, emittance, and degree-of-polarization curves in the optical region from 0.2 to 22.0 microns. The data have been categorized by subject and each curve plotted on a single graph. For some rocks and minerals, all curves of the same type, differing only in particle size, have been plotted on one grid as a composite plot. Each graph, composite or single, is fully titled to indicate curve source and is indexed by subject to facilitate user retrieval. Author

N72-31333*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

A FIRST-LOOK MACHINE ANALYSIS OF ERTS-1 DATA

David A. Landgrebe, Principal Investigator, R. M. Hoffer, Principal Investigator, and F. E. Goddard 29 Sep. 1972 22 p Presented as Preliminary Findings from Analyses of ERTS Observations, NASA Goddard Space Flight Center, Greenbelt, Md., 29 Sep. 1972 Original contains color illustrations. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(Contract NAS5-21773)

(E72-10042; NASA-CR-128122) Avail: NTIS HC \$3.25 CSSL 08B

N72-31341*# Environmental Research Inst. of Michigan, Ann Arbor.

COMPUTER PROCESSING OF ERTS-1 MSS DATA FROM THE SAN FRANCISCO FRAME

F. J. Thomson, Principal Investigator, M. Gordon, and J. Morgenstern 29 Sep. 1972 2 p ref Presented as Preliminary Findings from Analyses of ERTS Observations, NASA Goddard Space Flight Center, Greenbelt, Md., 29 Sep. 1972 Sponsored by NASA

(E72-10050; NASA-CR-128052; Rept-011229-4-S) Avail: NTIS HC \$3.00 CSSL 08F

N72-31342*# International Business Machines Corp., Gaithersburg, Md.

ERTS-1 ANALYSIS IN THE MONTEREY BAY AREA, USING DIGITAL TAPES

Ralph Bernstein, Principal Investigator and Charles Sheffield 27 Sep. 1972 1 p Presented as Preliminary Findings from Analyses of ERTS Observations, NASA Goddard Space Flight Center, Greenbelt, Md., 29 Sep. 1972 Sponsored by NASA Prepared in cooperation with Earth Satellite Corp.

(E72-10051; NASA-CR-128053) Avail: NTIS HC \$3.00 CSSL 08F

N72-31349*# Oregon State Univ., Corvallis.

THE ADVANTAGES OF SIDE-LAP STEREO INTERPRETATION OF ERTS-1 IMAGERY IN NORTHERN LATITUDES

Charles E. Poulton, Principal Investigator 29 Sep. 1972 4 p Presented as Preliminary Findings from Analyses of ERTS Observations, NASA Goddard Space Flight Center, Greenbelt, Md., 29 Sep. 1972 Sponsored by NASA

(E72-10058; NASA-CR-128060) Avail: NTIS HC \$3.00 CSSL 08F

07 DATA PROCESSING AND DISTRIBUTION SYSTEMS

N72-31350* American Univ., Washington, D.C.
INTERPRETATION OF WETLANDS ECOLOGY FROM ERTS
 Richard R. Anderson, Principal Investigator, Virginia Carter, and
 Bill McGinness 29 Sep. 1972 1 p Presented as Preliminary
 Findings from Analyses of ERTS Observations, NASA Goddard
 Space Flight Center, Greenbelt, Md., 29 Sep. 1972
 (Contract NAS5-21752)
 (E72-10059; NASA-CR-128081) Avail: NTIS HC \$3.00 CSCL
 08H

N72-31351* TRW Systems Group, Redondo Beach, Calif.
ERTS IMAGE DATA COMPRESSION TECHNIQUE
EVALUATION Monthly Progress Report, period ending
 1 Sep. 1972
 Donald J. Spencer, Principal Investigator and Curtis L. May
 5 Sep. 1972 1 p
 (Contract NAS5-21748)
 (E72-10087; NASA-CR-128034) Avail: NTIS HC \$3.00 CSCL
 08B

N72-31356* American Univ., Washington, D.C.
ERTS-1 DATA USER INVESTIGATION OF WETLAND
ECOLOGY Progress Report
 Richard R. Anderson, Principal Investigator 6 Sep. 1972 2 p
 Sponsored by NASA
 (E72-10073; NASA-CR-128088; PR-2) Avail: NTIS HC \$3.00
 CSCL 08H

N72-31367* Geological Survey, Washington, D.C.
ANALYSIS STUDY OF MULTISPECTRAL DATA, ERTS-A,
FROM AN AREA IN WEST PAKISTAN Progress Report, 1
 Jul. - 31 Aug. 1972
 Robert G. Schmidt, Principal Investigator 1 Sep. 1972 2 p
 Sponsored by NASA
 (E72-10102; NASA-CR-128161) Avail: NTIS HC \$3.00 CSCL
 08I

N72-32203* Kansas Univ., Lawrence. Space Technology
 Labs.
INTERPRETATION AND AUTOMATIC IMAGE ENHANCE-
MENT PROCESSING FACILITY Bimonthly Progress Report
 R. M. Haralick, Principal Investigator, Gerry Kelly, and K.
 Shanmugam 30 Sep. 1972 2 p Sponsored by NASA
 (E72-10125; NASA-CR-128179) Avail: NTIS HC \$3.00 CSCL
 09B

N72-32282* Alaska Univ., College.
COORDINATION AND ESTABLISHMENT OF CENTRALIZED
FACILITIES AND SERVICES FOR THE UNIVERSITY OF
ALASKA ERTS SURVEY OF THE ALASKAN ENVIRONMENT
 Bimonthly Progress Report
 Albert E. Belon, Principal Investigator 30 Sep. 1972 8 p
 Sponsored by NASA
 (E72-10139; NASA-CR-128193; BMPR-1) Avail: NTIS HC
 \$3.00 CSCL 14B

The author has identified the following significant results.
 Specifications have been prepared for the engineering design and
 construction of a digital color display unit which will be used for
 automatic processing of ERTS data. The color display unit is a
 disk refresh memory with computer interfaced input and a color
 cathode ray tube output display. The system features both
 analog and digital post disk data manipulation and a versatile
 color coding device suitable for displaying not only images, but
 also computer generated graphics such as diagrams, maps, and
 overlays. Input is from IBM compatible 9 track, 800 BPI tapes,
 as generated by an IBM 360 computer. ERTS digital tapes are
 read into the 360, where various analyses such as maximum
 likelihood classification are performed and the results are written
 on a magnetic tape which is the input to the color display unit.

The greatest versatility in the data manipulation area is provided
 by the minicomputer built into the color display unit, which is
 off-line from the main 360 computer. The minicomputer is able
 to read any line from the refresh disk and place it in its 4K-16
 bit memory. Considerable flexibility is available for post-processing
 enhancement of images by the investigator.

N72-32340* Purdue Univ., Lafayette, Ind. Lab. for Application
 of Remote Sensing.
AN INTERDISCIPLINARY ANALYSIS OF ERTS DATA FOR
COLORADO MOUNTAIN ENVIRONMENTS USING ADP
TECHNIQUES Bimonthly Progress Report, 1 Jul. 1972 -
 31 Aug. 1972
 Roger M. Hoffer, Principal Investigator 31 Aug. 1972 4 p
 (Contract NAS5-21880)
 (E72-10081; NASA-CR-128096) Avail: NTIS HC \$3.00 CSCL
 08E

Author identified significant preliminary results from the
 Ouchita portion of the Texoma frame of data indicate many
 potentials in the analysis and interpretation of ERTS data. It is
 believed that one of the more significant aspects of this analysis
 sequence has been the investigation of a technique to relate
 ERTS analysis and surface observation analysis. At present a
 sequence involving (1) preliminary analysis based solely upon the
 spectral characteristics of the data, followed by (2) a surface
 observation mission to obtain visual information and oblique
 photography to particular points of interest in the test site area,
 appears to provide an extremely efficient technique for obtaining
 particularly meaningful surface observation data. Following such
 a procedure permits concentration on particular points of interest
 in the entire ERTS frame and thereby makes the surface
 observation data obtained to be particularly significant and
 meaningful. The analysis of the Texoma frame has also been
 significant from the standpoint of demonstrating a fast turn
 around analysis capability. Additionally, the analysis has shown
 the potential accuracy and degree of complexity of features that
 can be identified and mapped using ERTS data.

N72-32370* Delaware Univ., Newark. College of Marine
 Studies.
IDENTIFICATION OF COASTAL VEGETATION SPECIES IN
ERTS-1 IMAGERY
 V. Klemas, Principal Investigator and D. Bartlett 4 Oct. 1972
 2 p Sponsored by NASA
 (E72-10120; NASA-CR-128169) Avail: NTIS HC \$3.00 CSCL
 08F

N72-32372* Kansas Univ., Lawrence. Remote Sensing Lab.
GROUND PATTERN ANALYSIS IN THE GREAT PLAINS
 Bimonthly Progress Report
 Dwight Egbert, John C. Davis, Principal Investigator, and Fawwaz
 T. Ulaby 30 Sep. 1972 7 p Sponsored by NASA
 (E72-10122; NASA-CR-128176) Avail: NTIS HC \$3.00 CSCL
 08H

The author has identified the following significant results.
 During preliminary analysis of the ERTS-1 RBV band-2 images it
 was possible to detect many geologic features and to delineate
 several geologic formation boundaries. Also, the spatial frequency
 characteristics of some different geologic formations are
 distinguishable from each other. At the present time there is not
 enough data to provide any statistical evaluation of these
 differences, but it is hoped that more quantitative results will be
 produced within the next few months. Multispectral analysis will
 begin when the retrospective order for the other spectral bands
 of the first images is received. Since many geologic formation
 boundaries are visible on the single band that has been analyzed
 so far, even greater visibility is expected with the spectral
 information available in the additional bands.

07 DATA PROCESSING AND DISTRIBUTION SYSTEMS

N72-32387* Geological Survey, Washington, D.C.
STUDY OF MULTISPECTRAL DATA, ERTS-A, NORTHWEST SAUDI ARABIA Progress Report, 1 Jul. - 31 Aug. 1972
 Alfred J. Bodenlos, Principal Investigator 1 Sep. 1972 2 p
 Sponsored by NASA
 (E72-10140; NASA-CR-128209) Avail: NTIS HC \$3.00 CSCL 05B

N72-32453* Kansas Univ., Lawrence. Space Technology Labs.
USE OF FEATURE EXTRACTION TECHNIQUES FOR THE TEXTURE AND CONTEXT INFORMATION IN ERTS IMAGERY Bimonthly Progress Report
 R. M. Haralick, Principal Investigator and K. Shanmugam 30 Sep. 1972 2 p Sponsored by NASA
 (E72-10124; NASA-CR-128178) Avail: NTIS HC \$3.00 CSCL 14B

N72-33299* Radio Corp. of America, Princeton, N.J. Astro-Electronics Div.
METEOROLOGICAL UTILITY OF HIGH RESOLUTION MULTISPECTRAL DATA Progress Report, period ending 30 Aug. 1972
 John M. Danko, Principal Investigator 30 Aug. 1972 2 p
 (Contract NAS5-21741)
 (E72-10065; NASA-CR-128081) Avail: NTIS HC \$3.00 CSCL 04B

N72-33309* International Business Machines Corp., Gaithersburg, Md.
ALL DIGITAL PROCESSING OF ERTS IMAGES Progress Report, period ending 30 Sep. 1972
 Ralph Bernstein, Principal Investigator 23 Oct. 1972 3 p
 (Contract NAS5-21716)
 (E72-10151; NASA-CR-128287) Avail: NTIS HC \$3.00 CSCL 09B

N72-33311* Environmental Research Inst. of Michigan, Ann Arbor.
COMPUTER PROCESSING OF ERTS-1 MSS DATA FROM THE SAN FRANCISCO FRAME (1003 - 18176)
 F. J. Thomson, Principal Investigator, M. Gordon, J. Morgenstern, and F. Sadowski 25 Jul. 1972 3 p Sponsored by NASA
 Original contains color illustrations. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
 (E72-10153; NASA-CR-128289; Rept-O11229-8-L) Avail: NTIS HC \$3.00 CSCL 09B

N72-33318* TRW Systems Group, Redondo Beach, Calif.
ERTS IMAGE DATA COMPRESSION TECHNIQUE EVALUATION Monthly Progress Report, period ending 1 Oct. 1972
 Donald J. Spencer, Principal Investigator 5 Oct. 1972 1 p
 Sponsored by NASA
 (E72-10161; NASA-CR-128312; TRW-7132.1-04) Avail: NTIS HC \$3.00 CSCL 09B

N73-10362* Smithsonian Astrophysical Observatory, Cambridge, Mass.
STUDIES OF IMAGES OF SHORT LIVED EVENTS USING ERTS DATA Progress Report, 1 Sep. - 31 Oct. 1972
 William A. Deutschman, Principal Investigator 31 Oct. 1972 2 p
 (Contract NAS5-21858)
 (E72-10183; NASA-CR-128332) Avail: NTIS HC \$3.00 CSCL 05B

N73-10368* Radio Corp. of America, Princeton, N.J.
METEOROLOGICAL UTILITY OF HIGH RESOLUTION MULTI-SPECTRAL DATA Progress Report, period ending 31 Oct. 1972
 John M. Danko, Principal Investigator 31 Oct. 1972 1 p
 (Contract NAS5-21741)
 (E72-10189; NASA-CR-128387) Avail: NTIS HC \$3.00 CSCL 04B

N73-10400* Auburn Univ., Ala. School of Engineering.
ERISTAR: EARTH RESOURCES INFORMATION STORAGE, TRANSFORMATION, ANALYSIS, AND RETRIEVAL ADMINISTRATIVE REPORT NASA/ASEE Systems Design Summer Faculty Program
 R. I. Vachon, J. Fred O'Brien, Jr., Russell E. Lueg, and J. E. Cox Sep. 1972 54 p Program held in Huntsville, Ala., 5 Jun. - 18 Aug. 1972
 (Grant NGT-01-003-044)
 (NASA-CR-61394) Avail: NTIS HC \$4.75 CSCL 05B

The 1972 Systems Engineering program at Marshall Space Flight Center where 15 participants representing 15 U.S. universities, 1 NASA/MSFC employee, and another specially assigned faculty member, participated in an 11-week program is discussed. The Fellows became acquainted with the philosophy of systems engineering, and as a training exercise, used this approach to produce a conceptual design for an Earth Resources Information Storage, Transformation, Analysis, and Retrieval System. The program was conducted in three phases; approximately 3 weeks were devoted to seminars, tours, and other presentations to subject the participants to technical and other aspects of the information management problem. The second phase, 5 weeks in length, consisted of evaluating alternative solutions to problems, effecting initial trade-offs and performing preliminary design studies and analyses. The last 3 weeks were occupied with final trade-off sessions, final design analyses and preparation of a final report and oral presentation. Author

N73-10444* Long Island Univ., Greenvale, N.Y. Science Engineering Research Group.
IN SITU SPECTRORADIOMETRIC QUANTIFICATION OF ERTS DATA Progress Report, period ending 15 Aug. 1972
 Edward Yost, Principal Investigator 16 Aug. 1972 1 p
 (Contract NAS5-21793)
 (E72-10173; NASA-CR-128364) Avail: NTIS HC \$3.00 CSCL 14B

N73-10445* Long Island Univ., Greenvale, N.Y. Science Engineering Research Group.
IN SITU SPECTRORADIOMETRIC QUANTIFICATION OF ERTS DATA Progress Report, period ending 15 Oct. 1972
 Edward Yost, Principal Investigator 20 Oct. 1972 1 p
 (Contract NAS5-21793)
 (E72-10174; NASA-CR-128365) Avail: NTIS HC \$3.00 CSCL 14E

N73-11167* Michigan Univ., Ann Arbor. Willow Run Labs.
[ERTS COMPUTER COMPATIBLE TAPE DATA PROCESSING AND ANALYSIS] Bimonthly Progress Report, 1 Jul. - 31 Aug. 1972
 Fabian C. Polcyn, Fred J. Thomson, L. J. Porcello, I. J. Settinger, W. A. Malila, C. T. Wezernak, and Robert Horvath, Principal Investigators 31 Aug. 1972 12 p
 (Contract NAS5-21783)
 (E72-10201; NASA-CR-129067; Rept-11229-3-L; BMPR-11) Avail: NTIS HC \$3.00 CSCL 09B

N73-11296* Michigan Univ., Ann Arbor. Willow Run Labs.
[ERTS COMPUTER COMPATIBLE TAPE DATA PROCESSING AND ANALYSIS. APPENDIX 1: THE UTILITY OF

IMAGING RADARS FOR THE STUDY OF LAKE ICE]

Bimonthly Progress Report, 1 Sep. - 31 Oct. 1972
 Fabian C. Polcyn, Fred J. Thomson, L. J. Porcello, I. J. Sattinger,
 W. A. Malila, C. T. Wozniak, Robert Horvath, Robert K. Vincent,
 Principal Investigators, and M. L. Bryan 31 Oct. 1972 30 p
 refs

(Contract NAS5-21783)
 (E72-10198; NASA-CR-129064; Rept-11229-10-L; BMPR-2)
 Avail: NTIS HC \$3.50 CSCL 08M

There are no author-identified significant results in this report. Remotely sensed multispectral scanner and return beam vidicon imagery from ERTS-1 is being used for: (1) water depth measurements in the Virgin Islands and Upper Lake Michigan areas; (2) mapping of the Yellowstone National Park; (3) assessment of atmospheric effects in Colorado; (4) lake ice surveillance in Canada and Great Lakes areas; (5) recreational land use in Southeast Michigan; (6) International Field Year on the Great Lakes investigations of Lake Ontario; (7) image enhancement of multispectral scanner data using existing techniques; (8) water quality monitoring of the New York Bight, Tampa Bay, Lake Michigan, Santa Barbara Channel, and Lake Erie; (9) oil pollution detection in the Chesapeake Bay, Gulf of Mexico southwest of New Orleans, and Santa Barbara Channel; and (10) mapping iron compounds in the Wind River Mountains.

A.L.

N73-11298*# Science Applications, Inc., La Jolla, Calif. DETERMINATION OF AEROSOL CONTENT IN THE ATMOSPHERE FROM ERTS-1 DATA Progress Report, 7 Sep. - 8 Nov. 1972

Claus B. Ludwig, Principal Investigator and M. Griggs 7 Nov.
 1972 11 p.
 (Contract NAS5-21860)

(E72-10200; NASA-CR-129066; SAI-72-589-LJ; PR-1) Avail:
 NTIS HC \$3.00 CSCL 04A

N73-11301*# Purdue Univ., Lafayette, Ind. Lab. for Application of Remote Sensing.

AN INTERDISCIPLINARY ANALYSIS OF ERTS DATA FOR
 COLORADO MOUNTAIN ENVIRONMENTS USING ADP
 TECHNIQUES. AN EARLY ANALYSIS OF ERTS-1 DATA
 Bimonthly Progress Report, 1 Sep. - 31 Oct. 1972

Roger M. Hoffer, D. A. Landgrebe, Principal Investigators, and
 F. E. Goodrick 31 Oct. 1972 29 p refs Original contains
 imagery. Original photography may be purchased from the EROS
 Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
 (Contract NAS5-21880)

(E72-10204; NASA-CR-128446; LARS-092672) Avail: NTIS
 HC \$3.50 CSCL 08G

There are no author-identified significant results in this report. The principal problem encountered has been the lack of good quality, small scale baseline photography for the test areas. Analysis of the ERTS-1 data for the San Juan Site will emphasize development of a preliminary spectral classification defining grass cover categories, and then selection of subframes for intensive investigation of the forestry, geologic, and hydrologic properties of the area. Primary work has been devoted to the selection and digitization of areas for topographic modeling, and compilation of ground based data maps necessary for computer analysis. Study effort has emphasized: geomorphic features; macro-vegetation; micro-vegetation; snow-hydrology; insect/disease damage; and blow-down. Analysis of a frame of the Lake Texoma area indicates a great deal of potential in the analysis and interpretation of ERTS imagery. Preliminary results of investigations of geologic, forest, range, cropland, and water resources of the area are summarized.

A.L.

N73-11302*# Earth Satellite Corp., Washington, D.C. FACILITATING THE EXPLOITATION OF ERTS IMAGERY USING SNOW ENHANCEMENT TECHNIQUES Semiannual Progress Report, 26 May - 31 Oct. 1972

Frank J. Wobber, Principal Investigator, Kenneth Martin, Charles

Sheffield, Orville Russell, and Roger Amato 16 Nov. 1972
 39 p Sponsored by NASA Original contains imagery. Original
 photography may be purchased from the EROS Data Center,
 10th and Dakota Avenue, Sioux Falls, S. D. 57198
 (E72-10205; NASA-CR-128470) Avail: NTIS HC \$4.00 CSCL
 08L

The author has identified the following significant results. Analysis of all available (Gemini, Apollo, Nimbus, NASA aircraft) small scale snow covered imagery has been conducted to develop and refine snow enhancement techniques. A detailed photographic interpretation of ERTS-simulation imagery covering the Feather River/Lake Tahoe area was completed and the 580-880nm. band was determined to be the optimum band for fracture detection. ERTS-1 MSS bands 5 and 7 are best suited for detailed fracture mapping. The two bands should provide more complete fracture detail when utilized in combination. Analysis of early ERTS-1 data along with U-2 ERTS simulation imagery indicates that snow enhancement is a viable technique for geological fracture mapping. A wealth of fracture detail on snow-free terrain was noted during preliminary analysis of ERTS-1 images 1077-15005-6 and 7, 1077-15011-5 and 7, and 1079-15124-5 and 7. A direct comparison of data yield on snow-free versus snow-covered terrain will be conducted within these areas following receipt of snow-covered ERTS-1 imagery.

N73-11303*# TRW Systems Group, Redondo Beach, Calif. EVALUATION OF DIGITAL CORRECTION OF TECHNIQUES FOR ERTS IMAGES Bimonthly Progress Report, Sep. Oct. 1972

John E. Taber, Principal Investigator Oct. 1972 3 p
 (Contract NAS5-21814)

(E72-10206; NASA-CR-128473) Avail: NTIS HC \$3.00 CSCL
 09B

N73-11308*# Arizona Univ., Tucson. EVALUATION OF ERTS-1 IMAGE SENSOR SPATIAL RESOLUTION IN PHOTOGRAPHIC FORM Progress Report

P. N. Slater, Principal Investigator and R. A. Schowengerdt Nov.
 1972 4 p

(Contract NAS5-21849)
 (E72-10213; NASA-CR-128484; PR-1) Avail: NTIS HC
 \$3.00 CSCL 14E

N73-11319*# TRW Systems Group, Redondo Beach, Calif. ERTS IMAGE DATA COMPRESSION TECHNIQUE EVALUA- TION Monthly Progress Report, period ending 1 Nov. 1972

Donald J. Spencer, Principal Investigator 3 Nov. 1972 1 p
 (Contract NAS5-21746)

(E72-10228; NASA-CR-129159; TRW-7132.1-08) Avail: NTIS
 HC \$3.00 CSCL 05B

N73-12153# Elliott-Automation Space and Advanced Military Systems, Ltd., Camberley (England).

SIDE-LOOKING RADAR SYSTEMS AND THEIR POTENTIAL
 APPLICATION TO EARTH RESOURCE SURVEYS. VOLUME
 2: RADAR SCATTERING FROM NATURAL SURFACES

R. A. Deane and A. R. Domville Aug. 1972 48 p refs
 (Contract ESTEC-1537/71/EL)

(ESRO-CR(P)-137) Avail: NTIS HC \$4.50

Data are given that show how natural surfaces reflect and scatter radio wavelengths of the type used in side-looking radar. Outlines of the theory are included for explanatory purposes. Measurements are quoted of the scattering properties of natural surfaces, including the sea. The way in which these properties influence SLR images is described, and the distinctions which can be drawn between different surfaces and surface conditions are deduced.

Author (ESRO)

N73-12355*# Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div. INVESTIGATION OF TECHNIQUES FOR CORRECTING

07 DATA PROCESSING AND DISTRIBUTION SYSTEMS

ERTS DATA FOR SOLAR AND ATMOSPHERIC EFFECTS
Bimonthly Progress Report, 1 Aug. - 1 Oct. 1972
Robert H. Rogers, Principal Investigator 1 Oct. 1972 7 p
(Contract NAS5-21863)
(E72-10255; NASA-CR-129187) Avail: NTIS HC \$3.00 CSCL 04A

N73-12360* Smithsonian Astrophysical Observatory, Cambridge, Mass.
AFAR AND ERTS-1 IMAGERY
Paul Mohr, Principal Investigator 1 Dec. 1972 1 p Submitted for publication
(Contract NAS5-21748)
(E72-10261; NASA-CR-129195) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. The excellent ERTS-1 imagery of the Afar region of Ethiopia permits a preliminary revision to the analysis of the structures of this triple-rift junction, and also revisions to the outcrops of some lithological formations. The fault-belts of the Afar floor can now be mapped in fine detail. The Danakil horst is identified to be limited on its western side against Afar by a major fault-line, and it seems unlikely that the horst is the exposed, easterly portion of a west-dipping sialic block underlying all northern Afar. The Salt Plain appears to be a true graben. The Ethiopian plateau-Afar margin consists of a series of right-offset sectors, the offsets being marked by silicic volcanic centers. The nature of these offsets is related to the vexed question of cross-rift faulting. Such faulting is identifiable on the ERTS-1 imagery, both on the Afar floor, and in the monoclinaly warped western margin. The significance of this faulting, though subordinate to the tensional faults of the fault-belts, awaits elucidation.

N73-12366* Rio Grande Soil and Water Research Center, Weslaco, Tex.
REFLECTANCE OF VEGETATION, SOIL, AND WATER
Progress Report, 19 Jun. - 19 Oct. 1972
Craig L. Wiegand, Principal Investigator 1 Dec. 1972 16 p
(NASA Order S-70251-AG)
(E72-10267; NASA-CR-129229) Avail: NTIS HC \$3.00 CSCL 08M

N73-12383* TRW Systems, Houston, Tex.
DESIGN REQUIREMENTS FOR OPERATIONAL EARTH RESOURCES GROUND DATA PROCESSING Mid-Term Report, 12 Jun. 1971 - 9 Jun. 1972
C. J. Baldwin, L. H. Bradford, E. S. Burnett, D. E. Hutson, B. A. Kinsler, D. R. Kugle, and D. S. Webber 12 May 1972 170 p refs
(Contract NAS9-12336)
(NASA-CR-129805) Avail: NTIS HC \$10.50 CSCL 05B
Realistic tradeoff data and evaluation techniques were studied that permit conceptual design of operational earth resources ground processing systems. Methodology for determining user requirements that utilize the limited information available from users is presented along with definitions of sensor capabilities projected into the shuttle/station era. A tentative method is presented for synthesizing candidate ground processing concepts.
F.O.S.

N73-12390* IIT Research Inst., Chicago, Ill. Engineering Mechanics Div.
EARTH RESOURCES DATA PROCESSOR Final Report
M. R. Phillips Oct. 1972 179 p
(Contract NAS8-26797)
(NASA-CR-61399; J62443-6) Avail: NTIS HC \$11.00 CSCL 05B

The recent development of manned and unmanned space vehicles has brought about an almost unprecedented advance in studies concerned with remotely sensed earth observations. With this advance comes an unprecedented amount of data. The

problem arises of how to efficiently analyze and compress unmanageable amounts of data into manageable amounts of useful information. A recently developed computer program is proposed as a partial solution to the above problem. The computer program is designed to determine the ground scene location and distribution of features extracted from remotely sensed earth observation data without human involvement in the data processing, or a priori knowledge of ground truth. Human involvement and judgement are reserved for identification of the features presented in the compressed data.
Author

N73-12903* Washington Univ., St. Louis, Mo.
COMPUTER PROGRAMS FOR PLOTTING SPOT-BEAM COVERAGES FROM AN EARTH SYNCHRONOUS SATELLITE AND EARTH-STATION ANTENNA ELEVATION ANGLE CONTOURS
Thomas W. Stagl and Jai P. Singh Oct. 1972 41 p refs
(Grant NGL-26-008-054)
(NASA-CR-129282; Memo-72/4) Avail: NTIS HC \$4.25 CSCL 22C

A description and listings of computer programs for plotting geographical and political features of the world or a specified portion of it, for plotting spot-beam coverages from an earth-synchronous satellite over the computer generated mass, and for plotting polar perspective views of the earth and earth-station antenna elevation contours for a given satellite location are presented. The programs have been prepared in connection with a project on Application of Communication Satellites to Educational Development.
Author

N73-13341* New York State Museum and Science Service, Albany.
GEOLOGICAL FEATURES AND SPECTRAL ANOMALIES IN SATELLITE IMAGERY OF THE ADIRONDACK MOUNTAIN RANGE
Yngvar W. Isachsen, Principal Investigator 12 Dec. 1972 1 p
(Contract NAS5-21764)
(E72-10291; NASA-CR-129281) Avail: NTIS HC \$3.00 CSCL 08F

N73-13342* International Business Machines Corp., Gaithersburg, Md.
ALL DIGITAL PRECISION PROCESSING OF ERTS IMAGES
Progress Report, period ending 30 Nov. 1972
Ralph Bernstein, Principal Investigator 8 Dec. 1972 4 p
(Contract NAS5-21716)
(E72-10292; NASA-CR-129303) Avail: NTIS HC \$3.00 CSCL 09B

N73-13345* Geological Survey, Washington, D.C.
STUDY OF MULTISPECTRAL DATA, ERTS-A, NORTHWEST SAUDI ARABIA Progress Report, 1 Sep. - 30 Oct. 1972
Alfred J. Bodenlos, Principal Investigator 1 Nov. 1972 2 p
(NASA Order S-70243-AG)
(E72-10295; NASA-CR-129287) Avail: NTIS HC \$3.00 CSCL 08F

N73-13369* Oceanographic Services, Inc., Santa Barbara, Calif.
ACQUISITION AND ANALYSIS OF COASTAL GROUND-TRUTH DATA FOR CORRELATION WITH ERTS-A IMAGERY Bimonthly Progress Report, 2 Oct. - 2 Dec. 1972
Richard C. Miller, Principal Investigator 21 Dec. 1972 2 p
(Contract NAS5-21877)
(E72-10321; NASA-CR-129579; BMPR-1) Avail: NTIS HC \$3.00 CSCL 08J

The author has identified the following significant results. Areas with high sediment loads and a wide range of water parameters (such as San Francisco Bay, an area not a target of this study but included in the imagery) show dramatic variations

in the photographs. Open oceanic areas off California have relatively homogenous water and hence a much lower range of contrast. The mean shore coastal areas show an intermediate range.

N73-13844* Pennsylvania State Univ., University Park.
INTERDISCIPLINARY APPLICATIONS AND INTERPRETATIONS OF REMOTELY SENSED DATA
G. W. Peterson and G. J. McMurtry / In NASA. Marshall Space Flight Center Space for Mankind's Benefit 1972 p 181-186
refs
CSCL 05H

N73-13874* Embassy of France, Washington, D.C.
SPACE BENEFITS TO MANKIND AS SEEN FROM A FRENCH POINT OF VIEW
Jean-Pierre M. Pujes / In NASA. Marshall Space Flight Center Space for Mankind's Benefit 1972 p 457-459

CSCL 05K

N73-14314*# Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.
INVESTIGATION OF TECHNIQUES FOR CORRECTING ERTS DATA FOR SOLAR AND ATMOSPHERIC EFFECTS
Bimonthly Progress Report
Robert H. Rogers, Principal Investigator 21 Dec. 1972 11 p
(Contract NAS5-21863)
(E72-10326; NASA-CR-129584) Avail: NTIS HC \$3.00 CSCL 03B

The author has identified the following significant results. The design and fabrication of five radiant power measuring instruments (RPMI) for ERTS ground truth have been completed. These instruments will be deployed in concert with ERTS overflights to obtain radiometric measurements needed to determine solar and atmospheric parameters that effect ERTS radiance measurements. With these parameters, the accuracy and capability of various procedures for transforming ERTS data into absolute target reflectance signatures will be evaluated. The RPMI is a rugged, hand-carried instrument accurately calibrated to measure both downwelling and reflected radiance within each ERTS multispectral scanner band. A foldover handle permits a quick change from wide angle global or sky irradiance measurements to narrow angle radiance measurements from sky and ground targets. These measurements yield ground truth site reflectance and permit calculation of additional parameters such as beam transmittance between spacecraft and ground, and path radiance (path reflectance).

N73-14316*# Geological Survey, Harrisburg, Pa.
PERFORMANCE OF THE ERTS DATA COLLECTION SYSTEM IN A TOTAL SYSTEM CONTEXT Progress Report, 1 Sep. 31 Oct. 1972
Richard W. Paulson, Principal Investigator 20 Nov. 1972 2 p
(NASA Order S-70243-AG)
(E72-10328; NASA-CR-129586) Avail: NTIS HC \$3.00 CSCL 05B

N73-14347*# Science Applications, Inc., La Jolla, Calif.
DETERMINATION OF AEROSOL CONTENT IN THE ATMOSPHERE FROM ERTS-1 DATA Progress Report, 7 Nov. 1972 - 6 Jan. 1973
Claus B. Ludwig, Principal Investigator and M. Griggs, 7 Jan. 1973 12 p
(Contract NAS5-21860)
(E72-10359; NASA-CR-129721; SAI72-605-LJ; PR-2) Avail: NTIS HC \$3.00 CSCL 04B

N73-14353*# TRW Systems Group, Redondo Beach, Calif.
EVALUATION OF DIGITAL CORRECTION OF TECHNIQUES FOR ERTS IMAGES Bimonthly Progress Report, Nov. Dec. 1972

John E. Taber, Principal Investigator and S. Rifman Dec. 1972 4 p
(Contract NAS5-21814)
(E72-10365; NASA-CR-129725) Avail: NTIS HC \$3.00 CSCL 09B

N73-14358*# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
ARCTIC AND SUBARCTIC ENVIRONMENTAL ANALYSES UTILIZING ERTS-1 IMAGERY. DISCIPLINE 8: INTERPRETATION TECHNIQUES DEVELOPMENT. SUBDISCIPLINE C: CLASSIFICATION AND PATTERN RECOGNITION
Duwayne M. Anderson, Principal Investigator [1973] 3 p
(NASA Order S-70253-AG)
(E72-10370; NASA-CR-129826) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. Uncontrolled photo mosaics of ERTS-1 imagery using MSS band 5 and 7 at a scale of 1:1,000,000 were used to make a preliminary surficial geology map in northcentral Alaska. Seven distinct geologic units were recognized, defined, and mapped directly on a photo mosaic. Results are closely correlated with published surficial geology maps. Eight MSS images were examined to test utility of ERTS data in studies of coastal processes and stream hydrology, and in the identification and interpretation of geomorphic features throughout Alaska. The feasibility of using ERTS-1 data to map structural lineaments is well illustrated on a mosaic of 8, band 5 MSS images. Along the northern edge of the Brooks Range one lineament can be followed the entire width of the mosaic, a distance of 225 miles. Two nearly parallel lineaments can be seen running along the northern and southern edges of the Schwatka Mountains. About 135 miles south of these two lineaments another series located in the Chitanana River region can be followed for 45 miles. These lineaments appear to be faults, and it is interesting to note that the Yukon River parallels these and appears to be structurally controlled.

A.L.

N73-14369* California Univ., Davis. Dept. of Electrical Engineering and Computer Sciences.
DIGITAL HANDLING AND PROCESSING OF REMOTE SENSING DATA
R. Algazi / In its An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Techniques 1 May 1972 30 p refs
CSCL 05B

Details of plans for developing a digital image processing facility to handle remote sensing data are reported. Also given are programs for data acquisition and handling, systems for use in programming various digital image processing tasks, and algorithms for feature enhancement. E.H.W.

N73-14370* California Univ., Davis. Dept. of Agricultural Engineering.
INVESTIGATION OF ATMOSPHERIC EFFECTS IN IMAGE TRANSFER
Kinsell L. Coulson / In its An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Techniques 1 May 1972 32 p
CSCL 04A

The effect of the atmosphere on remote image interpretation and transfer was studied under laboratory conditions. Indoor laboratory measurements were made of the reflection patterns of typical natural surfaces using a dual channel polarizing radiometer. Outdoor ground measurements of these same surfaces were compared to indoor ones to validate the findings. From these data attempts were made to construct an atmospheric remote sensing model that could predict spectral intensity

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characteristics of the remote image as seen by a particular sensor given the spatial orientation of the sensor, the atmospheric conditions, the time of day, and the type of surface being viewed.
E.H.W.

N73-15347*# TRW Systems Group, Redondo Beach, Calif.
PRELIMINARY RESULTS OF THE COMPUTER SIMULATION OF DATA COMPRESSION USING ERTS-A MSS DIGITAL TAPES

Donald J. Spencer, Principal Investigator and Curtis L. May 3 Jan. 1973 43 p
(Contract NAS5-21746)
(E73-10011; NASA-CR-129937) Avail: NTIS HC \$4.25 CSCL 05B

N73-15348*# TRW Systems Group, Redondo Beach, Calif.
ERTS IMAGE DATA COMPRESSION TECHNIQUE EVALUATION Monthly Progress Report, period ending 29 Dec. 1972
Donald J. Spencer, Principal Investigator 3 Jan. 1973 1 p
(Contract NAS5-21746)
(E73-10012; NASA-CR-129938) Avail: NTIS HC \$3.00 CSCL 05B

N73-15359*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
STUDIES OF IMAGES OF SHORT-LIVED EVENTS USING ERTS DATA Progress Report, 1 Nov. - 31 Dec. 1972
William A. Deutschman, Principal Investigator 31 Dec. 1972 3 p
(Contract NAS5-21858)
(E73-10025; NASA-CR-129955) Avail: NTIS HC \$3.00 CSCL 05B

The author has identified the following significant results. It has been possible to identify old fires in the Alaskan tundra and to monitor the development of active fires. The area burned can be quickly determined by a number of methods. The ERTS-1 satellite provides a convenient way to monitor fire damage in remote areas.

N73-15366*# Purdue Univ., Lafayette, Ind.
AN INTERDISCIPLINARY ANALYSIS OF ERTS DATA FOR COLORADO MOUNTAIN ENVIRONMENTS USING ADP TECHNIQUES Semiannual Report, 1 Jul. - 31 Dec. 1972
Roger M. Hoffer, Principal Investigator 31 Dec. 1972 18 p refs
(Contract NAS5-21880)
(E73-10033; NASA-CR-129986) Avail: NTIS HC \$3.00 CSCL 08F

There are no author-identified significant results in this report. Research efforts have been placed on: (1) location, acquisition, and preparation of baseline information necessary for the computer analysis, and (2) refinement of techniques for analysis of MSS data obtained from ERTS-1. Analysis of the first frame of data collected by the ERTS-1 multispectral scanner system over the Lake Texoma area has proven very valuable for determining the best procedures to follow in working with and analyzing ERTS data. Progress on the following projects is described: (1) cover type mapping; (2) geomorphology; and hydrologic feature surveys.
A.L.

N73-15372* National Aeronautics and Space Administration, Wallops Station, Wallops Island, Va.
GROUND TRUTH DATA REQUIREMENTS FOR ALTIMETER PERFORMANCE VERIFICATION
Edward J. Walsh in NOAA Sea Surface Topography from Space, Vol. 1 Feb. 1972 9 p

CSCL 08E

The amount and type of ground truth required for an altimeter

experiment is a function of the uncertainty in the satellite orbit, the altimeter error budget and the type of operation being performed. Ground truth requirements will be discussed with reference to three areas of operation: the global mode, the high intensity mode and calibration.
Author

N73-15462# East Tennessee State Univ., Johnson City. Remote Sensing Inst.

AN EVALUATION OF THE UTILITY OF AVAILABLE REMOTE SENSOR RETURNS FOR A STUDY OF SLOPE FAILURE PHENOMENA

Donald H. Poole 1971 40 p
(Contract N00014-67-A-0102-0001)
(AD-750735; TR-14) Avail: NTIS CSCL 08/6

The object of this investigation is to evaluate the utility of the photographs from NASA's North Carolina Test Site 46 for studying slope failure phenomena. Slope failure forms depicted by the photography include both erosional and mass wastage forms. The imagery made available to the investigator includes the following: Ektachrome, Ektachrome infrared, panchromatic, and multi-spectral nine-lens photography. The Ektachrome and Ektachrome infrared were available from each of the five missions conducted in the area of study (Missions 14, 23, 34, 53, and 65). The multi-spectral nine-lens was available from two missions (14 and 23), and the panchromatic photography was available from a single mission (14).
GRA

N73-15463# East Tennessee State Univ., Johnson City. Remote Sensing Inst.

THE DISTRIBUTION OF SLOPE FAILURE FORMS AS DEPICTED BY REMOTE SENSOR RETURNS

Donald H. Poole 1971 40 p
(Contract N00014-67-A-0102-0001)
(AD-750733; TR-13) Avail: NTIS CSCL 08/6

The objective of the study is to map the distribution of slope failure forms as they are depicted by the remote sensor photography made available to the investigator. No attempt has been made to regionalize their distribution, either quantitatively or qualitatively, except to note the general relationships existing between patterns of distribution and the rocks, soils, and land use practices characteristic of the study area.
GRA

N73-15464# East Tennessee State Univ., Johnson City. Remote Sensing Inst.

THE DEVELOPMENT OF CRITERIA FOR RECOGNIZING AND IDENTIFYING SLOPE FAILURE FORMS AS DEPICTED BY REMOTE SENSOR RETURNS

Donald H. Poole 1971 60 p
(Contract N00014-67-A-0102-0001)
(AD-750732; TR-12) Avail: NTIS CSCL 08/6

The study shows that the criteria developed from photographic images depicted by remote sensing photography from NASA's North Carolina Test Site is based largely on pattern, color contrast, and geometric form. Patterns are best reflected in the erosional forms of sheet wash, rill wash, and gully, and in the mass wastage forms of soil creep and rock fall and rock creep. Color contrast is significant in differentiating all erosional and mass wastage forms of slope failure. The color contrast between an object and its background is frequently the only means of establishing recognition. Geometric form is relied upon most often in recognizing and establishing the identity of the rapid forms of mass wastage, i.e. slump, earth flow, debris slide and rock slide.
GRA

N73-16160*# Aerojet ElectroSystems Co., Azusa, Calif.
EARTH RESOURCES DATA ANALYSIS SYSTEM Final Report

Oct. 1972 47 p
(Contract NAS9-12106)
(NASA-CR-128693; Rept-1746FR-1) Avail: NTIS HC \$4.50

CSCL 09B

The Earth Resources Laboratory Data Analysis System provides a valuable research tool in the evaluation of multispectral, radiometric, photographic, and passive microwave imagery data. The system has been in operational use for several months and has performed quite well. Emphasis on versatility of both the hardware and software design facilitates system expansion to many specialized data analysis tasks. The many independent software handlers provide building blocks for major processing programs. Author

N73-16306* Oceanographic Services, Inc., Santa Barbara, Calif.
ACQUISITION AND ANALYSIS OF COASTAL GROUND TRUTH DATA FOR CORRELATION WITH ERTS-A IMAGERY
 Bimonthly Progress Report, 2 Dec. 1972 - 2 Feb. 1973

Richard C. Miller, Principal Investigator 1 Feb. 1973 3 p
 (Contract NAS5-21877)
 (E73-10043; NASA-CR-130322; BMPR-2) Avail: NTIS HC \$3.00 CSCL 08C

The author has identified the following significant results. Examination of the digital image of Monterey Bay, California area indicates more resolution in all MSS bands than found in the film imagery. This inability to delineate subtle density variations may be similar to those difficulties encountered by some investigators at the light end of the spectrum. Because the digital image is large and only certain areas of the total image are enhanced at one time, the digital technique of presenting MSS imagery is complimentary with the supplied film imagery. Examination of selected film imagery of the Monterey Bay and Santa Barbara Channel areas raises more questions than can be answered at this time. Density variations over water areas could be of an oceanic or atmospheric origin, or both. The ground truth acquisition phase of this project will clear up some of the apparent ambiguities, but probably not completely. A more thorough examination of meteorological parameters is recommended.

N73-16310* American Univ., Washington, D.C. Dept. of Biology.

ERTS IMAGE ANALYSIS Preliminary Report

Norman H. MacLeod, Principal Investigator Jan. 1973 2 p
 (Contract NAS5-21892)
 (E73-10048; NASA-CR-130326; Rept-1) Avail: NTIS HC \$3.00 CSCL 05B

N73-16316* Tennessee Univ., Knoxville. Dept. of Electrical Engineering.

ERTS-A IMAGERY INTERPRETATION TECHNIQUES IN THE TENNESSEE VALLEY Progress Report

Robert E. Bodenheimer, Principal Investigator 2 Feb. 1973 4 p
 (Contract NAS5-21875)
 (E73-10054; NASA-CR-130332) Avail: NTIS HC \$3.00 CSCL 05B

N73-16318* Tennessee Univ., Knoxville. Dept. of Electrical Engineering.

ERTS-B IMAGERY INTERPRETATION TECHNIQUES IN THE TENNESSEE VALLEY

Rafael C. Gonzalez, Principal Investigator 26 Jan. 1973 91 p refs
 (Contract NAS5-21875)
 (E73-10058; NASA-CR-130334) Avail: NTIS HC \$6.75 CSCL 05B

There are no author-identified significant results in this report. The proposed investigation is a continuation of an ERTS-1 project. The principal missions are to serve as the principal supporter on computer and image processing problems for the multidisciplinary ERTS effort of the University of Tennessee, and to carry out research in improved methods for the computer processing, enhancement, and recognition of ERTS imagery.

N73-16368* Ministry of Public Works, Mexico City.

REMOTE SENSING PROGRAM AT TEST SITE 701, EL ORO-TLALPUJAHUA, MEXICO

Francisco Javier Toribio Arzate In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 1 1972 p 211-213

CSCL 08F

A comparison was conducted of the imagery obtained by panchromatic and infrared black and white aerial photography. The imagery was used to identify highway and railroad engineering accomplishments. The analysis indicated that color and infrared color photography provided the best imagery. Plans to use radar imagery are discussed. The tests were conducted in the vicinity of Test Site 701, Mexico. Author

N73-16378* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

THE INTERPRETATION OF SPECTRAL DATA

Marvin R. Holter In its Intern. Workshop on Earth Resources Surv. Systems, Vol. 1 1972 p 305-325

CSCL 05B

The characteristics and extent of data which is obtainable by electromagnetic spectrum sensing and the application to earth resources survey are discussed. The wavelength and frequency ranges of operation for various remote sensors are tabulated. The spectral sensitivities of various sensing instruments are diagrammed. Examples of aerial photography to show the effects of lighting and seasonal variations on earth resources data are provided. Specific examples of multiband photography and multispectral imagery to crop analysis are included. Author

N73-16380* Geological Survey, Washington, D.C.

INTERPRETATION OF SPATIAL RELATIONSHIPS

Frederick J. Doyle In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 1 1972 p 343-355 refs

CSCL 14B

Methods for interpreting spatial relationships resulting from remote sensor data acquisition are discussed. The effect of the three factors of scale, resolution, and spatial position on the quality of the data is described. Mathematical models and diagrams are provided to explain the effects of these parameters. Techniques for automatic image correlation and ERTS image processing are diagrammed. Distortions produced by various types of remote sensors are illustrated. Author

N73-16381* Interior Dept., Washington, D.C.

INTERPRETATION BY INTERDISCIPLINARY TEAMS

W. D. Carter In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 1 1972 p 357-366

CSCL 05B

The development and cooperation of interdisciplinary teams to find solutions to resource and environmental problems are examined. The composition of an ideal interdisciplinary team is proposed. The uses of remote sensor data for a specific test site in Arizona are tabulated. Samples of aerial photography are provided to explain the intricacies of data processing. Author

N73-16386* California Univ., Berkeley. Forestry Remote Sensing Lab.

FIELD DATA COLLECTION: AN ESSENTIAL ELEMENT IN REMOTE SENSING APPLICATIONS

Lawrence R. Pettinger In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 2 1971 p 48-64 refs

CSCL 05B

Field data collected in support of remote sensing projects are generally used for the following purposes: (1) calibration of remote sensing systems, (2) evaluation of experimental applications of remote sensing imagery on small test sites, and (3) designing and evaluating operational regional resource studies and inventories which are conducted using the remote sensing

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imagery obtained. Field data may be used to help develop a technique for a particular application, or to aid in the application of that technique to a resource evaluation or inventory problem for a large area. Scientists at the Forestry Remote Sensing Laboratory have utilized field data for both purposes. How meaningful field data has been collected in each case is discussed. Author

N73-17287*# California Univ., Berkeley. Space Sciences Lab. **AN INTEGRATED STUDY OF EARTH RESOURCES IN THE STATE OF CALIFORNIA BASED ON ERTS-1 AND SUPPORTING AIRCRAFT DATA** Progress Report

Robert N. Colwell, Gene A. Thorley, Robert Burgy, Gerald Schubert, John E. Estes, Leonore W. Bowden, Vidal R. Algazi, William E. Wildman, and Gordon L. Huntington, Principal Investigators 30 Sep. 1972 160 p Original contains color imagery. Original photography may be purchased from EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(Contract NAS5-21827)

(E73-10027; NASA-CR-130261) Avail: NTIS HC\$10.00 CSCL 08G

There are no author-identified significant results in this report. Results of an integrated study of earth resources in the state of California using ERTS-1 and supporting aircraft data are presented. Areas of investigation cover (1) regional agricultural surveys; (2) solving water resource management problems; (3) resource management in Northern California using ERTS-1 data; (4) analysis of river meanders; (5) assessment and monitoring change in west side of the San Joaquin Valley and central coastal zone of state; (6) assessment and monitoring of changes in Southern California environment; (7) digital handling and processing of ERTS-1 data; (8) use of ERTS-1 data in educational and applied research programs of the Agricultural Extension Service; and (9) identification, classification, and mapping of salt affected soils. A.L.

N73-17292*# International Business Machines Corp., Gaithersburg, Md. Federal Systems Center.

ALL DIGITAL PRECISION PROCESSING OF ERTS IMAGES Progress Report, 1 Dec. 1972 - 1 Feb. 1973

Ralph Bernstein, Principal Investigator 1 Feb. 1973 4 p (Contract NAS5-21716)

(E73-10080; NASA-CR-130278) Avail: NTIS HC\$3.00 CSCL 05B

The author has identified the following significant results. Experimentation was conducted to evaluate the performance of the Sequential Similarity Detection Algorithm (SSDA) to detect and locate ground central points (GCP) automatically using MSS data. Recent experiments with ERTS data having a temporal separation of from 17 to 72 days between the search area and the GCP have shown that the algorithm can find the GCP's and with an overall probability of 88%. Band 5 appears to give the best results. A modified reseau detection algorithm has been applied to 2 RBV scenes separated by a 12 day period. The algorithm correctly located all 486 reseaus. No false reseaus were located in a companion experiment. Changes in apparent reseau position, due to camera characteristics, were never greater than 3 picture elements in either axis. The positional error of a geometrically corrected image has been predicted by the use of an APL program. The maximum deviation of the GCP's from true UTM coordinate position was computed to be 190 meters. The RMS positional error of all GCP's was 106 meters. Further refinement of the algorithm is expected to reduce the errors.

N73-17297*# Radio Corp. of America, Princeton, N.J. Astro-Electronics Div.

METEOROLOGICAL UTILITY OF HIGH RESOLUTION MULTISPECTRAL DATA Progress Report, period ending 30 Jan. 1973

John M. Danko, Principal Investigator 30 Jan. 1973 15 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(Contract NAS5-21741)

(E73-10085; NASA-CR-130283) Avail: NTIS HC\$3.00 CSCL 04B

There are no author-identified significant results in this report. This investigation is directed towards determining the meteorological information content of ERTS-1 MSS bulk data at 0.6 - 0.7 microns as a function of resolution. To accomplish this, the resolution of the MSS data is degraded incrementally to 0.5 min. Subsequent analysis of the processed photographs in conjunction with surface and upper air observations will then determine to what extent significant meteorological information has been lost in the degradation process.

N73-17303*# Geological Survey, Harrisburg, Pa. **PERFORMANCE OF THE ERTS DATA COLLECTION SYSTEM IN A TOTAL SYSTEM CONTEXT** Progress Report, 1 Jul. - 31 Dec. 1972

Richard W. Paulson, Principal Investigator 26 Jan. 1973 3 p (NASA Order S-70243-AG)

(E73-10091; NASA-CR-130340) HC\$3.00 CSCL 05B

N73-17493*# TRW Systems Group, Redondo Beach, Calif. **ERTS IMAGE DATA COMPRESSION TECHNIQUE EVALUATION** Monthly Progress Report, period ending 1 Feb. 1973

Donald J. Spencer, Principal Investigator and Curtis L. May 7 Feb. 1973 1 p

(Contract NAS5-21746)

(E73-10287; NASA-CR-130570; TRW-7132.1-07) Avail: NTIS HC\$3.00 CSCL 05B

N73-17508# Sao Paulo Univ. (Brazil).

THE IMPORTANCE OF GROUND TRUTH DATA BY REMOTE SENSING [IMPORTANCIA DOS DADOS DE VERDADE TERRESTRE NO SENSORIAMENTO REMOTO]

Roger M. Hoffer 1972 20 p refs in PORTUGUESE (Rept-120371) Avail: NTIS HC\$3.00

The importance of remote sensing in resources management is reviewed. The sensing technology, ground truth, surface data, types of measurements, and remote sensing equipment are discussed. Transl. by F.O.S.

N73-18202*# Computer Sciences Corp., Huntsville, Ala. **PROCESSING FOR SPACEBORNE SYNTHETIC APERTURE RADAR IMAGERY**

M. Lybanon Washington NASA Feb. 1973 105 p refs (Contract NAS8-21805)

(NASA-CR-2193; M540) Avail: NTIS HC\$3.00 CSCL 09E

The data handling and processing in using synthetic aperture radar as a satellite-borne earth resources remote sensor is considered. The discussion covers the nature of the problem, the theory, both conventional and potential advanced processing techniques, and a complete computer simulation. It is shown that digital processing is a real possibility and suggests some future directions for research. Author

N73-18347*# Geological Survey, Washington, D.C. **ANALYSIS STUDY OF MULTISPECTRAL DATA, ERTS-A FROM AN AREA IN WEST PAKISTAN** Progress Report, 1 Nov. - 31 Dec. 1972

Robert G. Schmidt, Principal Investigator 1 Jan. 1973 2 p (NASA Order S-70243-AG)

(E73-10315; NASA-CR-130733) Avail: NTIS HC\$3.00 CSCL 08F

N73-18684*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

PROCEEDINGS OF THE CONFERENCE ON PARALLEL IMAGE PROCESSING FOR EARTH OBSERVATION SYSTEMS

Mar. 1972 192 p refs Conf. held at Greenbelt, Md., 2-3 Mar. 1972

(NASA-TM-X-66175; X-711-72-308) Avail: NTIS HC\$11.75 CSCL 20F

Conference papers are reported on optical and digital image processing techniques, problems of earth observation, and real time devices to convert from noncoherent to the coherent realm.

N73-18689* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DATA PROCESSING REQUIREMENTS FOR THE EARTH RESOURCES TECHNOLOGY SATELLITE (ERTS)
 John Y. Sos /In its Proc. of the Conf. on Parallel Image Process. for Earth Observation Systems Mar. 1972 p 61-70

CSCS 05B

N73-18690* General Electric Co., Philadelphia, Pa.
SPACE VEHICLE-BORNE APPLICATION OF OPTICAL DATA PROCESSING
 Joseph D. Welch /In NASA. Goddard Space Flight Center Proc. of the Conf. on Parallel Image Process. for Earth Observation Systems Mar. 1972 p 75-91

CSCS 20F

A model is considered for vehicle-borne parallel optical data processing which might be used as a key part of an advanced earth resources satellite mission. Some typical applications and the operation of the on-board processor are discussed. F.O.S.

N73-19341*# TRW Systems Group, Redondo Beach, Calif.
EVALUATION OF DIGITAL CORRECTION TECHNIQUES FOR ERTS IMAGES Semiannual Report, Sep. 1972 - Feb. 1973

Samuel S. Rifman, Principal Investigator Mar. 1973 26 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 (Contract NAS5-21814) (E73-10342; NASA-CR-130801) Avail: NTIS HC \$3.50 CSCS 14E

N73-19343*# Aerospace Corp., Los Angeles, Calif.
STUDY TO DEMONSTRATE THE FEASIBILITY OF AND DETERMINE THE OPTIMUM METHOD OF REMOTE HAZE MONITORING BY SATELLITE Progress Report
 Ernest H. Rogers, Principal Investigator 30 Nov. 1972 3 p (Contract NAS5-21719) (E73-10344; NASA-CR-130803) Avail: NTIS HC \$3.00 CSCS 03B

N73-19344*# Earth Satellite Corp., Washington, D.C.
FACILITATING THE EXPLOITATION OF ERTS IMAGERY USING SNOW ENHANCEMENT TECHNIQUES Bimonthly Progress Report, 1 Jan. - 28 Feb. 1973
 Frank J. Wobber, Principal investigator, Kenneth Martin, and Roger Amato 1 Mar. 1973 35 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 (Contract NAS5-21744) (E73-10345; NASA-CR-130804) Avail: NTIS HC \$3.75 CSCS 08L

The author has identified the following significant results. New fracture detail within New England test area has been interpreted from ERTS-1 images. Comparative analysis of snow-free imagery (1096-15065 and 1096-15072) has demonstrated that MSS bands 5 and 7 supply the greatest amount of geological fracture detail. Interpretation of the first snow-covered ERTS-1 images (1132-15074 and 1168-15065) in correlation with ground snow depth data indicates that a heavy blanket of snow (less than 9 inches) accentuates major structural features while a light dusting (greater than 1 inch) accentuates more subtle topographic expressions. Snow cover was found to accentuate drainage patterns which are indicative of lithological and/or structural variations. Snow cover provided added enhancement for viewing and detecting topographically expressed fractures and faults. A recent field investigation was conducted within the New England test area to field check lineaments observed from analysis of ERTS-1 imagery, collect snow depth readings, and obtain structural joint readings at key locations in the test area.

N73-19345*# Aerospace Corp., Los Angeles, Calif. Space Physics Lab.
REMOTE HAZE MONITORING BY SATELLITE: A STUDY TO DEMONSTRATE THE FEASIBILITY AND DETERMINE THE OPTIMUM METHOD Interim Report, May - Sep. 1972
 Ernest H. Rogers, Principal Investigator Mar. 1973 33 p refs (Contract NAS5-21719) (E73-10346; NASA-CR-130805) Avail: NTIS HC \$3.75 CSCS 03B

The author has identified the following significant results. A general purpose flexible computer program for the analysis of ERTS MSS data has been written for the Control Data 7600 computer. By putting all of the analysis operations into a separate subroutine the user may concentrate on the analysis. The problems of getting the information into the computer in convenient format is solved once and need not be tampered with each time a new analysis procedure is desired. The problems of getting information written by the XDS computers in 8 bit byte format into a convenient format for analysis on the 60 bit word format CDC 7600 computer are not trivial. A general purpose program to accomplish this has been written and is available from the investigators upon request.

N73-19350*# Long Island Univ., Greenvale, N.Y. Science and Engineering Research Group.
IN SITU SPECTRORADIOMETRIC QUANTIFICATION OF ERTS DATA Progress Report, Jul. - Dec. 1972
 Edward F. Yost, Principal Investigator Dec. 1972 49 p Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 (Contract NAS5-21793) (E73-10354; NASA-CR-130864; TR-21-1) Avail: NTIS HC \$4.50 CSCS 08M

The author has identified the following significant results. Additive color photographic analysis of ERTS-1 multispectral imagery indicates that the presence of soil moisture in playas (desert dry lakes) can be readily detected from space. Time sequence additive color presentations in which 600-700 nm bands taken at three successive 18-day cycles show that changes in soil moisture of playas with time can be detected as unique color signatures and can probably be quantitatively measured using photographic images of multispectral scanner data.

N73-19353*# Radio Corp. of America, Princeton, N.J.
METEOROLOGICAL UTILITY OF HIGH RESOLUTION MULTISPECTRAL DATA Progress Report, period ending 28 Feb. 1973
 J. Danko, Principal Investigator 28 Feb. 1973 4 p (Contract NAS5-21741) (E73-10357; NASA-CR-130972) Avail: NTIS HC \$3.00 CSCS 04B

N73-19368*# Environmental Research Inst. of Michigan, Ann Arbor.
PROCESSING OF ERTS-1 MULTISPECTRAL DATA OF INDIA
 Fred J. Thomson, Principal Investigator, R. D. Sharma, and J. Morgenstern Feb. 1973 11 p ref Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 (Contract NAS5-21783) (E73-10373; NASA-CR-131014; Rept-193301-4-L) Avail: NTIS CSCS 08F

N73-19375*# Geological Survey, Washington, D.C.
STUDY OF MULTISPECTRAL DATA, ERTS-A, NORTHWEST SAUDI ARABIA Progress Report, 1 Nov. - 31 Dec. 1972
 Alfred J. Bodenlos, Principal Investigator 9 Feb. 1973 2 p (NASA Order S-70243-AG) (E73-10380; NASA-CR-131021) Avail: NTIS HC \$3.00 CSCS 08F

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N73-20343* Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.
INVESTIGATION OF TECHNIQUES FOR CORRECTING ERTS DATA FOR SOLAR AND ATMOSPHERIC EFFECTS
 Interim Report, Aug. 1972 - Jan. 1973
 Robert H. Rogers, Principal Investigator Feb. 1973 34 p ref
 (Contract NAS5-21863)
 (E73-10349; NASA-CR-130823; BSR-4014) Avail: NTIS HC \$3.75 CSCL 04A

N73-20349* Environmental Research Inst. of Michigan, Ann Arbor.
[PROCESSING AND ANALYSIS OF ERTS-1 REMOTELY SENSED DATA] Bimonthly Report, 1 Jan. - 28 Feb. 1973
 Frederick J. Thomson, Principal Investigator 15 Mar. 1973 53 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
 (Contract NAS5-21783)
 (E73-10387; NASA-CR-131053; Rept-193300-6-L; BMR-4) Avail: NTIS CSCL 05B

Research progress on the processing, analysis, and management of ERTS-1 data is reported. Subject areas covered are: (1) water depth measurement in Little Bahama Bank; (2) terrain classification mapping of Yellowstone National Park, Wyoming; (3) atmospheric effects on ERTS-1 data; (4) lake ice surveillance in Michigan; (5) application of dielectric constant measurements to radar imagery interpretation; (6) recreational land use in Michigan; (7) IFYGL data on Lake Ontario and its drainage basin; (8) advanced information extraction techniques; (9) water quality monitoring in New York Bight and Tampa Bay areas; (10) oil pollution detection in Gulf of Mexico and waters off Salem, Massachusetts and Oakland, California; and (11) mapping iron ore deposits in Wind River Range, Wyoming.

N73-20351* Environmental Research Inst. of Michigan, Ann Arbor.
TASK 2: YELLOWSTONE NATIONAL PARK DATA, 1398
 Fred J. Thomson, Principal Investigator *In Its Process and Analysis of ERTS-1 Remotely Sensed Data* 15 Mar. 1973 1 p (For availability see N73-20349 11-13)
 (E73-10389) CSCL 08B

N73-20356* Environmental Research Inst. of Michigan, Ann Arbor.
TASK 7: IMAGE ENHANCEMENT AND ADVANCED INFORMATION EXTRACTION TECHNIQUES, 1398
 W. A. Mallia and R. F. Nalepka, Principal Investigators *In Its Process and Analysis of ERTS-1 Remotely Sensed Data* 15 Mar. 1973 9 p refs
 (E73-10394) CSCL 08F

The author has identified the following significant results. Atmospheric effects in satellite multispectral scanner data can influence results obtained with either manual image interpretation or computer information extraction techniques. The atmosphere attenuates radiation arriving from the surface and adds an extraneous path radiance component. Initial results of an investigation of atmospheric effects in ERTS-1 data are presented. Empirical analyses of ERTS-1 MSS data and simultaneous airborne MSS underflight data for one frame, along with theoretical calculations of atmospheric effects, are discussed. The effect of limited spatial resolution on the accuracy of information extracted from ERTS-1 data also is important. Problems occur when individual resolution elements contain two or more materials. Results from an initial application of Environmental Research Institute of Michigan techniques for estimating proportions of materials within individual elements are presented and discussed. Very accurate determination of surface areas of small lakes is achieved.

N73-20372* Geological Survey, Washington, D.C.
ANALYSIS STUDY OF MULTISPECTRAL DATA, ERTS-A, FROM AN AREA IN WEST PAKISTAN Progress Report, 1 Jan. - 28 Feb. 1973
 Robert G. Schmidt, Principal Investigator 7 Mar. 1973 3 p
 (NASA Order S-70243-AG)
 (E73-10410; NASA-CR-131148) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. Geomorphic features related to a known porphyry copper deposit at Saindak, western Chagai District, Pakistan, are easily distinguished on ERTS-1 images. New geologic information from the images was used in conjunction with known geology to evaluate one previously known prospect area and to suggest two additional ones, but no new prospects were recognized on the basis of the images alone. The study also showed that Saindak-type deposits are not likely to be present in some extensive areas of the Chagai District. The Saindak deposit is in an area of relatively easily eroded folded sedimentary and volcanic rocks. The deposit is characterized by an elongate zone of easily eroded sulfide-rich rock surrounded by a resistant rim of hornfels and propylitically altered rock. Both this rim and the central sulfide-rich valley are conspicuous features on the images. Swarms of dikes are probably useful for distinguishing real rims from other resistant rock types, but there is no expression of them on the image, although they are easily seen on aerial photographs of the Saindak rim. The investigation showed that a rim like that at Saindak does not form if regional metamorphism has increased the resistance of the country rock to erosion, as in the Pakistan-Iran border region northwest of Saindak.

N73-20390* Environmental Research Inst. of Michigan, Ann Arbor.
APPLICATION OF DIELECTRIC CONSTANT MEASUREMENTS TO RADAR IMAGERY INTERPRETATION
 M. Leonard Bryan and R. W. Larson Mar. 1973 25 p refs
 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
 (Contract NAS5-21783)
 (E73-10429; NASA-CR-131219; Rept-193300-4-S/J) Avail: NTIS HC \$3.25 CSCL 17I

The author has identified the following significant results. Although it is readily recognized that there is a need for ground truth to provide adequate guidance for remote sensing data interpretation, it is noted that, in terms of radar remote sensing, this ground truth is often inadequate. It is necessary to make basic electrical and physical measurements of the surface and to some depth below it. A brief outline is presented of a ground truth scheme which uses measurements of the dielectric constant. Two portable instruments were designed specifically for this purpose; these were: (1) a Q-meter for measurement of dielectric constant and loss tangent; and (2) an instrument to measure electrical properties of the two operating frequencies of the imaging radar. Although extensive data are lacking, several general cases of radar-earth surface and interaction are described; also, examples of radar imagery and some data on ice and snow are presented. It is concluded that the next logical step is to begin to quantify the radar ground truth in preparation for machine interpretation and automatic data processing of the radar imagery.

N73-20409* Arizona Univ., Tucson.
EVALUATION OF ERTS-1 IMAGE SENSOR SPATIAL RESOLUTION IN PHOTOGRAPHIC FORM Progress Report
 Philip N. Slater, Principal Investigator and R. A. Schowengerdt Mar. 1973 49 p refs
 (Contract NAS5-21849)
 (E73-10449; NASA-CR-131249; PR-3) Avail: NTIS HC \$4.50 CSCL 14F

The author has identified the following significant results. A coherent optical system was used to display the spatial frequency content of the amplitude image of one area of the ground as obtained in the four wavelength bands of the multispectral scanner. This enabled a rapid comparison to be

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made between the four bands, from which it was clear that bands 5 and 7 were preferred to the others in terms of image definition, and thus mapping and acreage estimation, for the particular agricultural area imaged. With suitable scaling it was also possible to compare the modulation, as a function of spatial frequency, of MSS bands 4 and 5 with the green (BB) and red (DD) bands of the same area from the Apollo 9, SO65 experiment. A significant result is that the modulation in the MSS amplitude imagery is 85%-90% of that in the Apollo 9 amplitude imagery. In addition, the ratio of spatial frequencies for the ERTS-1 and Apollo imagery, at which the same modulation occurs, lies between 0.55 and 0.75 for the red band. This ratio is closely related to the ratio of resolutions for the two sensors. These values corroborate statements that the resolution of the MSS imagery is better than anticipated by pre-flight predictions.

N73-20412* Smithsonian Astrophysical Observatory, Cambridge, Mass.
STUDIES OF IMAGES OF SHORT LIVED EVENTS USING ERTS DATA Progress Report, Sep. 1972 - Feb. 1973
 William A. Deutschman, Principal Investigator Mar. 1973 6 p
 (Contract NAS5-21858)
 (E73-10453; NASA-CR-131252) Avail: NTIS HC \$3.00 CSCL 14E

The author has identified the following significant results. The program to study short-lived events with the ERTS-1 satellite has evaluated 87 events reported by the Center for Short-Lived Phenomena. Forty-eight of these events were listed as candidates for ERTS-1 coverage and 8 of these were considered significant enough to immediately alert the ERTS operation staff by telephone. Studies of the images received from six events indicate that useful data on short-lived events can be obtained from ERTS-1 that would be difficult or impossible to obtain by other methods.

N73-20413* Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.
PRELIMINARY EVALUATION OF THE 15 OCTOBER 1972 ERTS-1 IMAGERY OF EAST CENTRAL OHIO (SCENE 1034-15418)
 Wayne A. Pettyjohn, Principal Investigator (Ohio State Univ.) Apr. 1973 18 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
 (Contract NAS5-21762)
 (E73-10454; NASA-CR-131254; BSR-3661) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. Results of a general, physical interpretation of ERTS-1 imagery of east central Ohio are presented. Special emphasis is placed upon geologic features, such as linear features and hydrologic features. Man-made features are included as a matter of interest and image location. The interpretation is compared to available maps of the area and from this an assessment that ERTS-1 is potentially useful for updating and producing geological maps.

N73-20423* Biospherics, Inc., Rockville, Md.
AIRBORNE MICROWAVE RADIOMETRIC DATA ANALYSIS Final Report
 22 May 1972 46 p
 (Contract NAS5-21674)
 (NASA-CR-130204) Avail: NTIS HC \$4.50 CSCL 08M

Results from the 1.5 cm, 19.35 GHz electrical scanning microwave radiometer which was one of the instruments used during the 1971 flight over Imperial Valley, California; Phoenix, Arizona; and Weslaco, Texas. Author

N73-21300* Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.
INVESTIGATION OF TECHNIQUES FOR CORRECTING

ERTS DATA FOR SOLAR AND ATMOSPHERIC EFFECTS Bimonthly Progress Report
 Robert H. Rogers, Principal Investigator 1 Apr. 1973 29 p
 ERTS
 (Contract NAS5-21863)
 (E73-10458; NASA-CR-131258) Avail: NTIS HC \$3.50 CSCL 08B

The author has identified the following significant results. A technique is described by which an ERTS investigator can obtain absolute target reflectances by correcting spacecraft radiance measurements for variable target irradiance, atmospheric attenuation, and atmospheric backscatter. A simple measuring instrument and the necessary atmospheric measurements are discussed, and examples demonstrate the nature and magnitude of the atmospheric corrections. Preliminary results indicate that the radiant power measuring instrument will provide one technique for calibrating ERTS-1 data. The March 27, 1973 mission was significant in the NASA C-130 aircraft and ERTS-1 simultaneously passed over the test sites where RPMI's were being deployed to measure solar and atmospheric parameters and site reflectance.

N73-21303* TRW Systems Group, Redondo Beach, Calif.
ERTS IMAGE DATA COMPRESSION TECHNIQUE EVALUATION Monthly Progress Report, period ending 1 Apr. 1973
 Donald J. Spencer, Principal Investigator 5 Apr. 1973 1 p
 ERTS
 (Contract NAS5-21746)
 (E73-10465; NASA-CR-131272) Avail: NTIS HC \$3.00 CSCL 08B

N73-21314* Tennessee Univ., Knoxville. Dept. of Electrical Engineering.
ERTS-A IMAGERY INTERPRETATION TECHNIQUES IN THE TENNESSEE VALLEY Semiannual Progress Report
 Robert E. Bodenheimer, Principal Investigator 15 Apr. 1973 13 p ERTS
 (Contract NAS5-21875)
 (E73-10477; NASA-CR-131287) Avail: NTIS HC \$3.00 CSCL 08B

N73-21316* Department of the Environment, Ottawa (Ontario).
DATA RETRANSMISSION FROM WATER SURVEY OF CANADA GAUGING STATIONS USING ERTS-1
 R. A. Halliday, Principal Investigator 23 Jan. 1973 7 p
 Presented at Ontario District Conf. of the Water Surv. of Can., Guelph, Ontario, 25 Jan. 1973 Sponsored by NASA ERTS
 (E73-10478; NASA-CR-131299) Avail: NTIS HC \$3.00 CSCL 08H

N73-21319* Oceanographic Services, Inc., Santa Barbara, Calif.
PROGRESS ON THE ACQUISITION AND ANALYSIS OF COASTAL GROUND TRUTH DATA FOR CORRELATION WITH ERTS-1 DATA Progress Report, 2 Oct. 1972 - 2 Apr. 1973
 William A. Anikouchine, Principal Investigator 1 Apr. 1973 17 p ERTS
 (Contract NAS5-21877)
 (E73-10482; NASA-CR-131302) Avail: NTIS HC \$3.00 CSCL 08B

N73-21330* Geological Survey, Harrisburg, Pa.
PERFORMANCE OF THE ERTS DATA COLLECTION SYSTEM IN A TOTAL SYSTEM CONTEXT Progress Report, 1 Jan. - 28 Feb. 1973
 Richard W. Paulson, Principal Investigator 21 Mar. 1973 3 p
 ERTS
 (NASA Order S-70243-AG)

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(E73-10494; NASA-CR-131314) Avail: NTIS HC \$3.00 CSCL 05B

The author has identified the following significant results. Approximately 70 percent of the DCP's being installed by Department of the Interior investigators have been successfully operated. These include DCP's operating in Iceland, Central America, Hawaii, and the Continental United States. The Data Collection System specifications are being met for frequency of data collection.

N73-21355* California Univ., Davis. Dept. of Electrical Engineering and Computer Sciences.
DIGITAL HANDLING AND PROCESSING OF REMOTE SENSING DATA

R. Algazi and D. Sakrison. In *its* An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Tech. 1 Feb. 1971 18 p refs Sponsored in part by AEC

(Grant NGL-05-003-404)
CSCL 05B

Progress is reported on the development of a computing facility that provides automatic processing of remote sensing data on earth resources. Preliminary work on digital signal processing algorithms and the writing of corresponding programs for the design of digital filters is outlined. G.G.

N73-22278* TRW Systems, Redondo Beach, Calif.
EVALUATION OF DIGITAL CORRECTION OF TECHNIQUES FOR ERTS IMAGES Bimonthly Progress Report, Mar. - Apr. 1973

John E. Taber, Principal Investigator and S. S. Rifman Apr. 1973 3 p refs ERTS
(Contract NAS5-21814)

(E73-10503; NASA-CR-131541) Avail: NTIS HC \$3.00 CSCL 05B

N73-22279* Department of the Environment, Ottawa (Ontario). Applied Hydrology Div.
WATER SURVEY OF CANADA: APPLICATION FOR USE OF ERTS-A FOR RETRANSMISSION OF WATER RESOURCES DATA Progress Report, Oct. 1972 - Mar. 1973

R. A. Halliday, Principal Investigator Apr. 1973 6 p Sponsored by NASA ERTS
(E73-10504; NASA-CR-131542) Avail: NTIS HC \$3.00 CSCL 08H

The author has identified the following significant results. Over 7000 transmissions were received from six operating DCPs in 1972. Of these, only two were incorrect. One had the wrong date and the other had an invalid digit in the water level reading. Extensive checks have indicated that DCP data are accurate. The maximum number of transmissions received each day varies from 26 to 12 and the minimum from 10 to 3 depending on the site. Data has been received on as many as seven orbits in a day. The number of transmissions received from the two DCPs located in mountainous areas of southern B.C. is lower than the number received from more northerly but more open sites. The unheated DCPs have survived temperatures of -40 F and antenna loadings of two feet of snow and wind speeds over 50 mph. Two DCPs have indicated sensor malfunctions thus alerting field staff to the fact that repairs will be necessary on their next visit to the site. Also in another case, DCP data were used to fill in a period of missing record when a water level recorder malfunctioned for a few days.

N73-22289* Arizona Univ., Tucson.
EVALUATION OF ERTS-1 IMAGE SENSOR SPATIAL RESOLUTION IN PHOTOGRAPHIC FORM Progress Report P. N. Slater, Principal Investigator and R. A. Schowengerdt May 1973 6 p ERTS
(Contract NAS5-21849)
(E73-10521; NASA-CR-131488; PR-4) Avail: NTIS HC \$3.00 CSCL 14E

N73-22291* Science Applications, Inc., La Jolla, Calif.
DETERMINATION OF AEROSOL CONTENT IN THE ATMOSPHERE FROM ERTS-1 DATA Progress Report, 7 Mar. 1972 - 6 May 1973

M. Griggs, Principal Investigator 7 May 1973 11 p ERTS
(Contract NAS5-21860)

(E73-10524; NASA-CR-131491; SAI-73-537-LJ; PR-4) Avail: NTIS CSCL 04B

N73-22297* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

AN INTERDISCIPLINARY ANALYSIS OF MULTISPECTRAL SATELLITE DATA FOR SELECTED COVER TYPES IN THE COLORADO MOUNTAINS, USING AUTOMATIC DATA PROCESSING TECHNIQUES Monthly Progress Report

Roger M. Hoffer, Principal Investigator Apr. 1973 3 p EREP
(Contract NAS9-13380)

(E73-10533; NASA-CR-131598) Avail: NTIS HC \$3.00 CSCL 08F

N73-22333* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

AN INTERPRETATION OF A GEOLOGIC MAP OF FANNIN COUNTY, TEXAS, PREPARED BY ADP TECHNIQUES FROM ERTS MSS DATA

J. A. Henderson, Jr., J. J. Gardner (Indiana State Univ.), and J. E. Cipra 1973 11 p refs Presented at Remote Sensing Conf., Tullahoma, Tenn., 26-28 Mar. 1973

(Contract NAS5-21785; Grant NGL-15-005-112)

(NASA-CR-131574; LARS-Info-Note-031673) Avail: NTIS HC \$3.00 CSCL 08G

Multispectral scanner data, collected by ERTS-1 from an area in northeast Texas underlain by structurally simple cretaceous sedimentary rocks, were analyzed using several automatic data processing techniques. Training areas for the computer analysis were selected in three ways using: (1) an unsupervised classifier, (2) the unsupervised classifier to further refine training areas, and (3) available ground information. The first two methods utilize the capability of the unsupervised classifier to group resolution elements with similar spectral properties. With the imagery produced by these procedures, several geologic features can be identified. The most easily recognizable features are streams and other water bodies. The approximate location of contacts between several rock units can be mapped. Author

N73-22368* Army Coastal Engineering Research Center, Washington, D.C.

COASTAL IMAGERY DATA BANK Interim Report

Andre Szuwalski Nov. 1972 55 p

(AD-755508; CERC-Misc-Paper-3-72) Avail: NTIS CSCL 08/2

Report provides information about a Coastal Imagery Data Bank being compiled by CERC. The data bank will consist of a systematic index identifying available aerial photographs of the coastal areas of the United States. Compilation is scheduled for completion in fiscal year 1977. This interim report covers data compiled through fiscal year 1972. Imagery for the index is compiled by the Defense Manning Agency Topographic Center (DMATC) under support and direction of CERA. Author (GRA)

N73-22413* Army Foreign Science and Technology Center, Charlottesville, Va.

INVESTIGATION OF OPTICAL PROPERTIES ON NATURAL OBJECTS AND THEIR AERIAL PHOTOGRAPHIC IMAGE FORMATION

Yu. K. Yutsenich 8 Dec. 1972 249 p refs Transl. into ENGLISH of the book "Issled. Optich. Svoistv Prirodn. ob Ektov i ikh Aerogotografiches" Leningrad, 1970 169 p
(AD-756803; FSTC-HT-23-1757-72) Avail: NTIS CSCL 14/5

A critical survey is given of studies conducted on optical

parameters of natural formations. The author has shown that for purposes of aerial photography, the optical properties of natural formations can describe with adequate completeness their spectral coefficients of brightness (SCB). Data are given on the accuracy of determining the SCB of natural formations necessary for the contemporary state of art of aerial photography. The author examines the factors modifying the SCB values of natural formations. A survey is given of the instruments, plus an analysis of their suitability for determining the SCB under natural conditions. A conclusion is made to the effect that at the present time, the extent of our knowledge concerning the optical properties of natural formations is inadequate both from quantitative and geographic standpoints; the data available on the SCB lack the necessary generality. Recommendations are given on improving the study of optical parameters of natural formations. GRA

N73-23432*# Geological Survey, Miami, Fla.
ACQUISITION AND PROCESSING PROBLEM OF ERTS DATA IN SOUTH FLORIDA Progress Report, 1 Oct. 1972 - 1 Apr. 1973

A. L. Higer, Principal Investigator, E. T. Wimberly, E. H. Cordes, and A. E. Coker Apr. 1973 21 p ref Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 (NASA Order S-70243-AG-7) (E73-10560; NASA-CR-131859) Avail: NTIS HC \$3.25 CSCL 05B

N73-23435*# Environmental Research Inst. of Michigan, Ann Arbor.

DEVELOPING PROCESSING TECHNIQUES FOR SKYLAB DATA Monthly Progress Report, 8 Mar. - 8 Apr. 1973

Richard F. Nalepka, Principal Investigator 8 May 1973 1 p EREP

(Contract NAS9-13280)

(E73-10563; NASA-CR-131862; Rept-101900-1-L; MR-1) Avail: NTIS HC \$3.00 CSCL 05B

N73-23437*# Mississippi Test Facility, Bay St. Louis.

EVALUATION OF SATELLITE REMOTE SENSING AND AUTOMATIC DATA TECHNIQUES FOR CHARACTERIZATION OF WETLANDS AND MARSHLANDS Progress Report Robert H. Cartmill, Principal Investigator 8 May 1973 2 p ERTS

(E73-10576; NASA-TM-X-69226) Avail: NTIS HC \$3.00 CSCL 08M

N73-23449*# TRW Systems Group, Redondo Beach, Calif.

ERTS IMAGE DATA COMPRESSION TECHNIQUE EVALUATION Monthly Progress Report, period ending 1 Dec. 1972 Donald J. Spencer, Principal Investigator 1 Dec. 1972 1 p ERTS

(Contract NAS5-21746)

(E73-10589; NASA-CR-131905; TRW-7132.1-06) Avail: NTIS HC \$3.00 CSCL 05B

N73-23453*# Kansas Univ./Center for Research, Inc., Lawrence. Remote Sensing Lab.

INTERPRETATION AND AUTOMATIC IMAGE ENHANCEMENT FACILITY Progress Report, Aug. 1972 - Jan. 1973

R. M. Haralick, Principal Investigator and Sam Shanmugan Jan. 1973 9 p ERTS

(Contract NAS5-21822)

(E73-10596; NASA-CR-131912) Avail: NTIS HC \$3.00 CSCL 14B

The author has identified the following significant results. Efforts to provide data processing support for ERTS-1 investigators in Kansas are summarized. Programs have been developed for data retrieval, feature extraction, and classification of digital MSS

data. The IDECS/PDP-15 facility at the University of Kansas Remote Sensing Laboratory has been used for quick look analysis of ERTS-1 imagery. Programs have been developed for studying fresh water bodies in ERTS-1 imagery over Kansas on the IDECS.

N73-23472*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

EARTH RESOURCES GROUND DATA HANDLING SYSTEMS FOR THE 1980'S

Edgar M. VanVleck, Kenneth F. Sinclair, Samuel W. Pitts, and Robert E. Slye Mar. 1973 151 p refs

(NASA-TM-X-62240) Avail: NTIS HC \$9.75 CSCL 05B

The system requirements of an operational data handling system for earth resources in the decade of the 1980's are investigated. Attention is drawn to problems encountered in meeting the stringent agricultural user requirements of that time frame. Such an understanding of requirements is essential not only in designing the ground system that will ultimately handle the data, but also in design studies of the earth resources platform, sensors, and data relay satellites which may be needed. Author

N73-24348* Environmental Research Inst. of Michigan, Ann Arbor.

ATMOSPHERIC EFFECTS IN ERTS-1 DATA, TASK 3

Frederick J. Thomson, Principal Investigator *In its* ERTS-1 Invest. conducted by Environ. Res. Inst. of Mich. 9 May 1973 1 p ERTS

(E73-10568) CSCL 08B

N73-24352* Environmental Research Inst. of Michigan, Ann Arbor.

IMAGE ENHANCEMENT AND ADVANCED INFORMATION EXTRACTION TECHNIQUES, TASK 7

W. A. Malila, Principal Investigator and R. F. Nalepka *In its* ERTS-1 Invest. conducted by Environ. Res. Inst. of Mich. 9 May 1973 3 p ERTS

(E73-10572) CSCL 05B

N73-24357*# Mississippi Test Facility, Bay St. Louis.

EVALUATION OF SATELLITE REMOTE SENSING AND AUTOMATIC DATA TECHNIQUES FOR CHARACTERIZATION OF WETLANDS AND MARSHLANDS Progress Report Robert H. Cartmill, Principal Investigator 8 May 1973 2 p ERTS

(E73-10590; NASA-TM-X-69218) Avail: NTIS HC \$3.00 CSCL 08H

N73-24368*# Oceanographic Services, Inc., Santa Barbara, Calif.
ACQUISITION AND ANALYSIS OF COASTAL GROUND TRUTH DATA FOR CORRELATION WITH ERTS-1 IMAGERY Bimonthly Progress Report

William A. Anikouchine, Principal Investigator 4 Jun. 1973 8 p ERTS

(Contract NAS5-21877)

(E73-10607; NASA-CR-132004; BMPR-3) Avail: NTIS HC \$3.00 CSCL 08H

N73-24385*# TRW Systems Group, Redondo Beach, Calif.

ERTS IMAGE DATA COMPRESSION TECHNIQUE EVALUATION Monthly Progress Report, period ending 1 Jun. 1973

Donald J. Spencer, Principal Investigator 8 Jun. 1973 2 p ERTS

(Contract NAS5-21746)

(E73-10625; NASA-CR-132036; TRW-7132.1-20) Avail: NTIS HC \$3.00 CSCL 05B

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N73-24392*# Tennessee Univ., Knoxville. Dept. of Electrical Engineering.

ERTS-A IMAGERY INTERPRETATION TECHNIQUES IN THE TENNESSEE VALLEY Progress Report, 25 Mar. - 25 May 1973

Robert E. Bodenheimer, Principal Investigator 4 Jun. 1973 2 p ERTS

(Contract NAS5-21875)

(E73-10633; NASA-CR-132092) Avail: NTIS HC \$3.00 CSCL 05B

N73-24410*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

UNSUPERVISED SPATIAL CLUSTERING WITH SPECTRAL DISCRIMINATION

Robert R. Jayroe, Jr. Washington May 1973 91 p refs (NASA-TN-D-7312; M-107) Avail: NTIS HC \$3.00 CSCL 05B

The development of a computer program is reported for extracting features from remotely sensed data presented in digital image form. This computer program requires no human supervision or prejudgment and operates unassisted on the raw digital data. A condensed general background is included on remote sensing of earth features and a short synopsis on some of the most commonly used types of feature extraction techniques. Results obtained from the unsupervised feature extraction computer program along with a description and listing of the computer program are presented. Author

N73-24411*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

IDENTIFICATION AND MAPPING OF SOILS, VEGETATION, AND WATER RESOURCES OF LYNN COUNTY, TEXAS BY COMPUTER ANALYSIS OF ERTS MSS DATA

Marion F. Baumgardner, Steven J. Kristof, and James A. Henderson, Jr. 1973 11 p

(Grant NGL-15-005-112)

(NASA-CR-132956; LARS-030373) Avail: NTIS HC \$3.00 CSCL 08H

The results of the analysis and interpretation of ERTS multispectral data obtained over Lynn County, Texas are presented. The test site was chosen because it embodies a variety of problems associated with the development and management of agricultural resources in the Southern Great Plains. The utility of ERTS data in identifying, characterizing and mapping soils, vegetation, and water resources in this semiarid region is examined. Preliminary results from this study suggest that ERTS data may be used successfully in semiarid regions to accomplish the above tasks. Author

N73-24491*# Eastman Kodak Co., Rochester, N.Y. Kodak Apparatus Div.

PHOTOGRAPHIC CONSULTING SERVICES FOR EARTH RESOURCES PROGRAM AT NASA GODDARD SPACE FLIGHT CENTER

21 Mar. 1973 63 p

(Contract NASw-2317)

(NASA-CR-131819) Avail: NTIS HC \$5.25 CSCL 14E

A comparison of prints from ERTS photography revealed significant differences in the image quality produced at GSFC, the EROS facility at Sioux Falls, and Eastman Kodak in Rochester. Based on this survey photographic quality was improved significantly at Sioux Falls, and improvements were suggested for optical and contact printers at the GSFC. Based on a test in which 365 meters of Eastman Electron Recording Film (ESTAR Base) SO-438 were processed the 1-sigma variation in process control from all sources is about + or - 0.04 at a density of 1.0. Variations from film and from processing were approximately equal contributors to the overall tolerance. Distortion produced by the Kodak Colorado printer at GSFC covers a range of about 0.04%, a small value compared to that caused by other factors in the ERTS system. The edge fringing inherent in the color film materials used at GSFC also seems to be a small factor in the unsharpness of ERTS color prints. MTF and granularity measurements were made on processed film samples supplied by GSFC. MTF values were above 0.70 out to 42 cycles/mm for all stages of contact printing in the ERTS system. Author

N73-25334*# Earth Satellite Corp., Washington, D.C.

FACILITATING THE EXPLOITATION OF ERTS-1 IMAGERY UTILIZING SNOW ENHANCEMENT TECHNIQUES Progress Report, 1 Sep. 1972 - 30 Apr. 1973

Frank J. Wobber, Principal Investigator, Kenneth R. Martin, and Roger V. Amato 24 May 1973 64 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21744)

(E73-10594; NASA-CR-131910) Avail: NTIS HC \$5.25 CSCL 05B

The author has identified the following significant results. Snow cover in combination with low angle solar illumination has been found to provide increased tonal contrast of surface feature and is useful in the detection of bedrock fractures. Identical fracture systems were not as readily detectable in the fall due to the lack of a contrasting surface medium (snow) and a relatively high sun angle. Low angle solar illumination emphasizes topographic expressions not as apparent on imagery acquired with a higher sun angle. A strong correlation exists between the major fracture-lineament directions interpreted from multi-sensor imagery (including snow-free and snow cover ERTS) and the strike of bedrock joints recorded in the field indicating the structural origin of interpreted fracture-lineaments. A fracture-annotated ERTS-1 photo base map (1:250,000 scale) is being prepared for western Massachusetts. The map will document the utilization of ERTS-1 imagery for geological analysis in comparative snow-free and snow-covered terrain.

N73-25343*# TRW Systems Group, Redondo Beach, Calif.

ERTS IMAGE DATA COMPRESSION TECHNIQUE EVALUATION Monthly Progress Report, period ending 1 Mar. 1973 Donald J. Spencer, Principal Investigator 9 Mar. 1973 1 p ERTS

(Contract NAS5-21746)

(E73-10647; NASA-CR-132238; TRW-7132.1-09) Avail: NTIS HC \$3.00 CSCL 05B

N73-25373*# Smithsonian Astrophysical Observatory, Cambridge, Mass.

STUDIES OF IMAGES OF SHORT-LIVED EVENTS USING ERTS DATA Progress Report, 1 Mar. - 30 Apr. 1973

William A. Deutschman, Principal Investigator 30 Apr. 1973 2 p ERTS

(Contract NAS5-21858)

(E73-10678; NASA-CR-132184) Avail: NTIS HC \$3.00 CSCL 05B

The author has identified the following significant results. Of significance are the continued detection and analysis of such short-lived events as forest fires, oil spills, vegetation damage, volcanoes, storm ridges, and earthquakes.

N73-25394*# Science Applications, Inc., La Jolla, Calif.

DETERMINATION OF AEROSOL CONTENT IN THE ATMOSPHERE FROM ERTS-1 DATA Progress Report, 7 May 1972 - 6 Jul. 1973

M. Griggs, Principal Investigator 7 Jul. 1973 15 p ERTS

(Contract NAS5-21860)

(E73-10702; NASA-CR-133015; SAI-73-665-LJ; PR-6) Avail: NTIS HC \$3.00 CSCL 04A

The author has identified the following significant results. Significant results have been obtained using the digital data from ERTS-1. A linear relationship, as predicted by theory, has been shown to exist between the MSS radiances over water surfaces and the aerosol content of the atmosphere measured with a ground-based Volz sun photometer. The relationship, based on seven data points, appears best for MSS 6. This relationship will enable the atmospheric aerosol content to be monitored on a global basis, once it has been verified with further measurements, and should provide the information with considerable cost-savings over a ground-based photometer network.

N73-25396* TRW Systems Group, Redondo Beach, Calif.
EVALUATION OF DIGITAL CORRECTION TECHNIQUES FOR ERTS IMAGES Bimonthly Progress Report, May - Jun. 1973

John E. Taher, Principal Investigator Jun. 1973 3 p ERTS
 (Contract NAS5-21814)
 (E73-10705; NASA-CR-133018) Avail: NTIS HC \$3.00 CSCL 05B

N73-25889* Sperry Rand Research Center, Sudbury, Mass.
THERMASONDE DATA PROCESSING TECHNIQUES Final Report

W. D. Mount, A. C. Anway, B. R. Fow, C. M. Maloy, and C. V. Wick Oct. 1972 114 p refs
 (Contract EPA-71-26)
 (PB-214184/4; SRRC-CR-72-5; EPA-R3-72-022) Avail: NTIS HC \$3.00 CSCL 04B

A study was conducted in which three data processing techniques developed under the previous contract were refined and tested on a small sample of simulated and observed radiometric data. The report is organized as follows: Section 2 is devoted to the simulation discrepancy. The present state of the art for the simulating the observed antenna temperatures and the impact of this capability upon system performance is discussed. Section 3 describes the data processing techniques. Specific work performed in developing each technique is discussed. Section 4 discusses the effects of a non ideal antenna pattern, with a detailed description of a method of formulating the analysis of these effects. Section 5 contains the conclusions derived from this work and their implications. Author

N73-25910* Alabama Univ., Huntsville.
IMAGE PROCESSING TECHNIQUES AND APPLICATIONS TO THE EARTH RESOURCES TECHNOLOGY SATELLITE PROGRAM Final Technical Report

R. J. Polge, B. K. Bhagavan, and L. Callas May 1973 121 p refs
 (Contract NAS8-28545)
 (NASA-CR-124285; UAH-RR-141) Avail: NTIS HC \$8.25 CSCL 14E

The Earth Resources Technology Satellite system is studied, with emphasis on sensors, data processing requirements, and image data compression using the Fast Fourier and Hadamard transforms. The ERTS-A system and the fundamentals of remote sensing are discussed. Three user applications (forestry, crops, and rangelands) are selected and their spectral signatures are described. It is shown that additional sensors are needed for rangeland management. An on-board information processing system is recommended to reduce the amount of data transmitted. Author

N73-26324* TRW Systems Group, Redondo Beach, Calif.
ERTS IMAGE DATA COMPRESSION TECHNIQUE EVALUATION Monthly Progress Report, period ending 1 May 1973

Donald J. Spencer, Principal Investigator 7 May 1973 2 p ERTS
 (Contract NAS5-21746)
 (E73-10717; NASA-CR-133217; TRW-7132.1-15) Avail: NTIS HC \$3.00 CSCL 05B

N73-26327* National Marine Fisheries Service, Bay Saint Louis, Miss.
REMOTE SENSING DATA MANAGEMENT FROM A USER'S VIEWPOINT

William H. Stevenson, Principal Investigator and Thomas A. Vanselow May 1973 12 p ERTS
 (NASA Order S-70246-AG)
 (E73-10720; NASA-CR-133220) Avail: NTIS HC \$3.00 CSCL 05B

The author has identified the following significant results. An experimental data bank in conjunction with the National Marine

N73-26336* TRW Systems Group, Redondo Beach, Calif.
ERTS IMAGE DATA COMPRESSION TECHNIQUE EVALUATION Monthly Progress Report, period ending 1 Jul. 1973

Donald J. Spencer, Principal Investigator 9 Jul. 1973 2 p ERTS
 (Contract NAS5-21746)
 (E73-10730; NASA-CR-133074; TRW-7132.1-25) Avail: NTIS HC \$3.00 CSCL 05B

The author has identified the following significant results. Tapes of compressed ERTS data were obtained to permit later reconstruction and to prove that in general four ERTS MSS tapes can be put onto a single compressed tape. A compressed tape was reconstructed and imagery made. The data were compressed using the essentially information preserving SSDIAM algorithm, with mappings of from 1 to 3 levels and imagery was made of the result. This imagery shows that no visual degradation results from the one level mapping while compression is significantly increased. Mappings of up to three levels shows negligible deterioration in areas of moderate to high data activity, but contouring is noticeable in areas of uniform data such as the plains region.

N73-26343* Long Island Univ., Greenvale, N.Y. Science Engineering Research Group.

IN SITU SPECTRORADIOMETRIC QUANTIFICATION OF ERTS DATA Progress Report, 15 Dec. 1972 - 15 Feb. 1973

Edward Yost, Principal Investigator 15 Feb. 1973 2 p ERTS
 (Contract NAS5-21793)
 (E73-10737; NASA-CR-133081; ERTS-069) Avail: NTIS HC \$3.00 CSCL 05B

The author has identified the following significant results. A multispectral photo analysis of the Willcox Playa was also made using ERTS imagery on three consecutive overpasses. The results of the analysis showed that a time sequential multispectral color presentation relates color to environmental changes as a function of time, rather than spectral changes for any single date. Since the primary mission of ERTS is to detect changes in the environment, it is believed that this mode of data reduction would be employed further in conjunction with the conventional techniques.

N73-26344* Long Island Univ., Greenvale, N.Y. Science Engineering Research Group.

IN SITU SPECTRORADIOMETRIC QUANTIFICATION OF ERTS DATA Progress Report, 15 Feb. 1973 - 15 Apr. 1973

Edward Yost, Principal Investigator 15 Apr. 1973 2 p ERTS
 (Contract NAS5-21793)
 (E73-10738; NASA-CR-133082; ERTS-069) Avail: NTIS HC \$3.00 CSCL 05B

N73-26346* Earth Satellite Corp., Washington, D.C.
FACILITATING THE EXPLOITATION OF ERTS IMAGERY USING SNOW ENHANCEMENT TECHNIQUES Bimonthly Progress Report, 1 May - 30 Jun. 1973

Frank J. Wobber, Principal Investigator, Kenneth Martin, and Roger Amato 6 Jul. 1973 14 p ERTS
 (Contract NAS5-21744)
 (E73-10741; NASA-CR 133085) Avail: NTIS HC \$3.00 CSCL 08L

The author has identified the following significant results. Detection and analysis of fracture systems can be more effectively conducted utilizing snow cover as an enhancement tool. From analysis within the Great Barrington Test Site it appears that the use of aeromagnetic data effectively supplements lineament data acquired using ERTS imagery. Coincidence of lineaments derived from aeromagnetics with lineaments interpreted from ERTS imagery apparently indicate the presence of mineralized fracture systems and dikes. Utilizing both tools can increase the speed and efficiency of mineral exploration and geological mapping in areas where bedrock is obscured by a thick unconsolidated sediment cover.

07 DATA PROCESSING AND DISTRIBUTION SYSTEMS

Fisheries Service's Fisheries Engineering Laboratory's (FEL) participation in the ERTS-1 program was established. The data management system was demonstrated to be effective in the performance of the NMFS-FEL ERTS-1 experiment involving several input sources and varying user requirements. The system is to be further evaluated under similar conditions during FEL participation in the Skylab and ERTS-B experiments.

N73-26351* National Environmental Satellite Services, Hillcrest Heights, Md. Environmental Sciences Group.
ERTS-1 ANOMALOUS DARK PATCHES
 Alan E. Strong, Principal Investigator 13 Jul. 1973 2 p
 ERTS
 (NASA Order S-70246-AG)
 (E73-10747; NASA-CR-133115) Avail: NTIS HC \$3.00 CSCL 14E

The author has identified the following significant results. Through combined use of imagery from ERTS-1 and NOAA-2 satellites it was found that when the sun elevation exceeds 55 degrees, the ERTS-1 imagery is subject to considerable contamination by sunlight even though the actual specular point is nearly 300 nautical miles from nadir. Based on sea surface wave slope information, a wind speed of 10 knots will theoretically provide approximately 0.5 percent incident solar reflectance under observed ERTS multispectral scanner detectors. This reflectance nearly doubles under the influence of a 20 knot wind. The most pronounced effect occurs in areas of calm water where anomalous dark patches are observed. Calm water at distances from the specular point found in ERTS scenes will reflect no solar energy to the multispectral scanner, making these regions stand out as dark areas in all bands in an ocean scene otherwise composed by a general diffuse sunlight from rougher ocean surfaces. Anomalous dark patches in the outer parts of the glitter zones may explain the unusual appearance of some scenes.

N73-26352* Environmental Research Inst. of Michigan, Ann Arbor.
[SL-3 DATA REQUIREMENTS]
 Lester V. Manderscheid, Principal Investigator 3 Jul. 1973 1 p
 EREP
 (Contract NAS9-13332)
 (E73-10748; NASA-CR-133116) Avail: NTIS HC \$3.00 CSCL 05B

N73-26473* Environmental Research Inst. of Michigan, Ann Arbor.
DEVELOPING PROCESSING TECHNIQUES FOR SKYLAB DATA Monthly Report, 1 May 1973
 Richard F. Nelepka, Principal Investigator 13 Jun. 1973 1 p
 EREP
 (Contract NAS9-13280)
 (E73-10758; NASA-CR-133126; MR-3) Avail: NTIS HC \$3.00 CSCL 05B

N73-26616* Texas Technological Univ., Lubbock. Dept. of Mathematics and Statistics.
THEORY AND ANALYSIS OF STATISTICAL DISCRIMINANT TECHNIQUES AS APPLIED TO REMOTE SENSING DATA
 Final Technical Report, 1 Jun. 1972 - 31 May 1973
 Patrick L. Odell May 1973 189 p refs
 (Contract NAS9-12775)
 (NASA-CR-128988) Avail: NTIS HC \$11.50 CSCL 12A

Classification of remote earth resources sensing data according to normed exponential density statistics is reported. The use of density models appropriate for several physical situations provides an exact solution for the probabilities of classifications associated with the Bayes discriminant procedure even when the covariance matrices are unequal. G.G.

N73-27242* Environmental Research Inst. of Michigan, Ann Arbor.
DEVELOPING PROCESSING TECHNIQUES FOR SKYLAB DATA Monthly Report, 8-30 Apr. 1973
 Richard F. Nelepka, Principal Investigator 18 May 1973 1 p
 EREP
 (Contract NAS9-13280)
 (E73-10765; NASA-CR-133132; Rept-101300-4-L; MR-2) Avail: NTIS HC \$3.00 CSCL 05B

N73-27274* South Dakota State Univ., Brookings. Remote Sensing Inst.
STATE OF READINESS
 Victor I. Myers, Principal Investigator 22 May 1973 3 p
 EREP
 (Contract NAS9-13337)
 (E73-10798; NASA-CR-133204) Avail: NTIS HC \$3.00 CSCL 05B

N73-27276* Research Triangle Inst., Durham, N.C.
[DEVELOPMENT OF MATHEMATICAL MODELS FOR PROCESSING ALTIMETER DATA] Monthly Progress Report, 1-31 May 1973
 Lee S. Miller, Principal Investigator and Gary S. Brown 11 Jun. 1973 2 p EREP
 (Contract NAS9-13304)
 (E73-10801; NASA-CR-133208) Avail: NTIS HC \$3.00 CSCL 05B

N73-27286* Research Triangle Inst., Durham, N.C.
[COORDINATION OF GROUND TRUTH AND BASIC ALTIMETER DATA PROCESSING REQUIREMENTS]
 Monthly Progress Report, 1-30 Apr. 1973
 Lee S. Miller and Gary S. Brown, Principal Investigators 11 May 1973 4 p EREP
 (Contract NAS9-13304)
 (E73-10811; NASA-CR-133295) Avail: NTIS HC \$3.00 CSCL 05B

N73-27287* Research Triangle Inst., Durham, N.C.
[DEVELOPMENT OF MATHEMATICAL MODELS FOR PROCESSING S-193 RADAR ALTIMETER DATA] Monthly Progress Report, 1-3 Jun. 1973
 Lee S. Miller and Gary S. Brown, Principal Investigators 11 Jul. 1973 2 p EREP
 (Contract NAS9-13304)
 (E73-10812; NASA-CR-133296) Avail: NTIS HC \$3.00 CSCL 05B

N73-27299* International Business Machines Corp., Gaithersburg, Md.
ALL-DIGITAL PRECISION PROCESSING OF ERTS IMAGES
 Interim Report, Aug. 1972 - Jun. 1973
 Ralph Bernstein, Principal Investigator Jul. 1973 44 p refs
 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
 (Contract NAS5-21716)
 (E73-10827; NASA-CR-133332) Avail: NTIS HC \$4.25 CSCL 05B

The author has identified the following significant results. ERTS-1 MSS and RBV data recorded on computer compatible tapes have been analyzed and processed, and preliminary results have been obtained. No degradation of intensity (radiance) information occurred in implementing the geometric correction.

The quality and resolution of the digitally processed images are very good, due primarily to the fact that the number of film generations and conversions is reduced to a minimum. Processing times of digitally processed images are about equivalent to the NDPF electro-optical processor. The next phase of the effort involves the completion of geometric and radiometric analyses, the production and evaluation of annotated MSS and RBV images, error and configuration analyses, and further studies of the utility of the SSDA algorithm and of filtering techniques.

N73-27853* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
ELECTRON BEAM RECORDER IMAGE CORRECTION FOR ERTS

Paul Heffner *In its Significant Accomplishments in Technol.*, 1972 1973 p 155-158

CSCL 148

N73-27854* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
A PHOTOGRAPHIC PROCESSING CONTROL METHOD FOR ERTS IMAGERY

Bernard Peavey *In its Significant Accomplishments in Technol.*, 1972 1973 p 159-166

CSCL 14E

N73-28221* Centro Interamericano de Fotointerpretacion, Bogota (Colombia).
INTERPRETATION OF ERTS-MSS IMAGES OF A SAVANNA AREA IN EASTERN COLOMBIA

G. W. W. Elbersson *In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 105-119* Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-A13) CSCL 08F

The application of ERTS-1 imagery for extrapolating existing soil maps into unmapped areas of the Llanos Orientales of Colombia, South America is discussed. Interpretations of ERTS-1 data were made according to conventional photointerpretation techniques. Most units delineated in the existing reconnaissance soil map at a scale of 1:250,000 could be recognized and delineated in the ERTS image. The methods of interpretation are described and the results obtained for specific areas are analyzed.

Author

N73-28236* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
A COMPARISON OF GEMINI AND ERTS IMAGERY OBTAINED OVER SOUTHERN MOROCCO

Herbert W. Blodget and Arthur T. Anderson *In its Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 265-272* refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-G5) CSCL 08B

A mosaic constructed from three ERTS MSS band 5 images enlarged to 1:500,000 compares favorably with a similar scale geologic map of southern Morocco, and a near-similar scale Gemini 5 photo pair. A comparative plot of lineations and generalized geology on the three formats show that a significantly greater number of probable fractures are visible on the ERTS imagery than on the Gemini photography, and that both orbital formats show several times more lineaments than were previously mapped. A plot of mineral occurrences on the structural overlays indicates that definite structure-mineralization relationships exist; this finding is used to define underdeveloped areas which are prospective for mineralization. More detailed mapping is possible using MSS imagery than on Gemini 5 photographs, and in addition, the ERTS format is not restricted to limited coverage.

Author

N73-28243* Earth Satellite Corp., Washington, D.C.
EXPLOITATION OF ERTS-1 IMAGERY UTILIZING SNOW ENHANCEMENT TECHNIQUES

Frank J. Wobber and Kenneth R. Martin *In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 345-351* refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-G12) CSCL 08L

Photogeological analysis of ERTS-simulation and ERTS-1 imagery of snowcovered terrain within the ERAP Feather River site and within the New England (ERTS) test area provided new fracture detail which does not appear on available geological maps. Comparative analysis of snowfree ERTS-1 images has demonstrated that MSS Bands 5 and 7 supply the greatest amount of geological fracture detail. Interpretation of the first snow-covered ERTS-1 images in correlation with ground snow depth data indicates that a heavy blanket of snow (more than 9 inches) accentuates major structural features while a light 'dusting' (less than 1 inch) accentuates more subtle topographic expressions. An effective mail-based method for acquiring timely ground-truth (snowdepth) information was established and provides a ready correlation of fracture detail with snow depth so as to establish the working limits of the technique. The method is both efficient and inexpensive compared with the cost of similarly scaled direct field observations.

Author

N73-28318* Pennsylvania State Univ., University Park. Office for Remote Sensing of Earth Resources.
THE USE OF THE TEMPORAL DIMENSION IN CLASSIFYING AND MAPPING ERTS-1 MSS DATA

F. Y. Borden and D. N. Applegate *In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1059-1068* ref ERTS

(Paper-L23) CSCL 08B

Multispectral data from two ERTS-1 scenes of the same central Pennsylvania area were brought into registration by translation and then merged. The two scenes were viewed on different dates, but from adjacent ground tracks, as frequent cloud cover in Pennsylvania made it impossible to choose two scenes from the same track. Targets selected to be mapped included river water, railroad yards, creeks, urban areas, industrial areas, and vegetation. Equivalent training areas were chosen from each of the original scenes and from the merged data. Classification maps were produced for each, and a comparison was made. Scene brightness was found to have the most important effect on classification differences.

Author

N73-28323* Environmental Research Inst. of Michigan, Ann Arbor.

ATMOSPHERIC EFFECTS IN ERTS-1 DATA, AND ADVANCED INFORMATION EXTRACTION TECHNIQUES

William A. Malila and Richard F. Walepka *In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1097-1104* refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-I1) CSCL 04B

Atmospheric effects in satellite multispectral scanner data can influence results obtained with either manual image interpretation or computer information extraction techniques. The atmosphere attenuates radiation arriving from the surface and adds an extraneous path radiance component. Initial results of an investigation of atmospheric effects in ERTS data are presented. Empirical analyses of ERTS MSS data and simultaneous airborne MSS underflight data for one frame, along with theoretical calculations of atmospheric effects, are discussed. The effect of limited spatial resolution on the accuracy of information extracted from ERTS data also is important. Problems occur when individual resolution elements contain two or more materials.

07 DATA PROCESSING AND DISTRIBUTION SYSTEMS

Results from an initial application of ERIM techniques for estimating proportions of materials within individual elements are presented and discussed. Very accurate determination of surface areas of small lakes is achieved. Author

N73-28325* Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.

A TECHNIQUE FOR THE CORRECTING ERTS DATA FOR SOLAR AND ATMOSPHERIC EFFECTS

Robert H. Rogers and Keith Peacock *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1115-1122 ERTS

(Paper-13) CSCL 05B

A technique is described by which an ERTS investigator can obtain absolute target reflectances by correcting spacecraft radiance measurements for variable target irradiance, atmospheric attenuation, and atmospheric backscatter. A simple measuring instrument and the necessary atmospheric measurements are discussed, and examples demonstrate the nature and magnitude of the atmospheric corrections. Author

N73-28327* TRW Systems Group, Redondo Beach, Calif. **DIGITAL RECTIFICATION OF ERTS MULTISPECTRAL IMAGERY**

Samuel S. Rifman *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1131-1142 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-16) CSCL 05B

Rectified ERTS multispectral imagery have been produced utilizing all digital techniques, as the first step toward producing precision corrected imagery. Errors arising from attitude and ephemeris sources have been corrected, and the resultant image is represented in a meter/meter mapping utilizing an intensity resampling technique. Early results from available data indicate negligible degradation of the photometric and resolution properties of the source data as a consequence of the geometric correction process. Work utilizing ground control points to produce precision rectified imagery, and including photometric corrections resulting from available sensor calibration data, is currently in progress. Author

N73-28328* International Business Machines Corp., Gaithersburg, Md. Federal Systems Div. **RESULTS OF PRECISION PROCESSING (SCENE CORRECTION) OF ERTS-1 IMAGES USING DIGITAL IMAGE PROCESSING TECHNIQUES**

Ralph Bernstein *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1143-1150 refs ERTS

(Contract NAS5-21718)

(Paper-17) CSCL 05B

ERTS-1 MSS and RBV data recorded on computer compatible tapes have been analyzed and processed, and preliminary results have been obtained. No degradation of intensity (radiance) information occurred in implementing the geometric correction. The quality and resolution of the digitally processed images are very good, due primarily to the fact that the number of film generations and conversions is reduced to a minimum. Processing times of digitally processed images are about equivalent to the NDPF electro-optical processor. Author

N73-28329* Lockheed Electronics Co., Houston, Tex. Aerospace Systems Div.

SIGNIFICANT TECHNIQUES IN THE PROCESSING AND INTERPRETATION OF ERTS-1 DATA

S. B. Cousin, A. C. Anderson, J. F. Paris, and J. F. Potter *In* NASA. Goddard Space Flight Center Symp. on Significant

Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1151-1158 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-18) CSCL 05B

The discipline oriented investigations underway at the Johnson Space Center (JSC) using ERTS-1 data provide an appropriate framework for the systematic evaluation of the various elements comprising a prototype multispectral data processing and analysis system. In particular such a system may be thought of as the integration of: (1) a preprocessing subsystem; (2) a spectral clustering subsystem; (3) a correlation and classification subsystem; (4) mensuration subsystem; and (5) an information management subsystem. Specific elements of this system are already operational at JSC. It is in the context of this system that technique development and application is being pursued at JSC. Aircraft, ERTS and EREP data will be utilized to refine the subsystem elements for each of the data acquisition systems or system combinations that are optimally suited for a specific Earth Resources application. The techniques reported are those that have been developed to date during the utilization of ERTS-1 data in this processing and analysis system. Author

N73-28330* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

COMPUTER TECHNIQUES USED FOR SOME ENHANCEMENTS OF ERTS IMAGES

Fred C. Billingsley and Alex F. H. Goetz *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1159-1167 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS7-100)

(Paper-19) CSCL 05B

The JPL VICAR image processing system has been used for the enhancement of images received from the ERTS for the Arizona geology mapping experiment. This system contains flexible capabilities for reading and repairing MSS digital tape images, for geometric corrections and interpicture registration, for various enhancements and analyses of the data, and for display of the images in black and white and color. Author

N73-28331* California Univ., Davis. Dept. of Electrical Engineering.

DIGITAL ENHANCEMENT OF MULTISPECTRAL MSS DATA FOR MAXIMUM IMAGE VISIBILITY

Vidal Raphael Algaiz *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1169-1177 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-110) CSCL 05B

A systematic approach to the enhancement of images has been developed. This approach exploits two principal features involved in the observation of images: the properties of human vision and the statistics of the images being observed. The rationale of the enhancement procedure is as follows: in the observation of some features of interest in an image, the range of objective luminance-chrominance values being displayed is generally limited and does not use the whole perceptual range of vision of the observer. The purpose of the enhancement technique is to expand and distort in a systematic way the grey scale values of each of the multispectral bands making up a color composite, to enhance the average visibility of the features being observed. Author

N73-28332* California Univ., Riverside. Dept. of Geography. **ERTS-1 IMAGE ENHANCEMENT BY OPTICALLY COMBINING DENSITY SLICES**

Gerald O. Tapper and Robert W. Pease *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1179-1185

refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-111) CSCL 05B

The technique of density slicing using a photographic film and its application to enhancement of ERTS-1 imagery has proved to be useful for mapping variegated areal phenomena and provides a useful supplement of the I2S MiniAddcol viewing system. The initial experiments conducted with this film were encouraging, and indicated that this technique of density slicing using readily accessible darkroom facilities and simple darkroom procedures allows rapid, accurate, and facile interpretation of certain areal phenomena to be made from the imagery. The distribution of the tree yucca, *Yucca brevifolia* Jaegeriana, in the eastern Mojave Desert of Southern California and southern Nevada was used as an example to test the accuracy of the technique for mapping purposes. The distribution was mapped at a relatively high level of accuracy. Author

N73-28333* RAND Corp., Santa Monica, Calif.

PSEUDOCOLOR TRANSFORMATION OF ERTS IMAGERY
Jeanine Lamar and Paul M. Merifield (Earth Sci. Res. Corp.)
In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1187-1198 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-112) CSCL 05B

One of the photographic techniques which shows great promise as an aid in interpreting ERTS imagery is pseudocolor transformation. It is a process where each shade of gray in an original black-and-white image is seen as a different color in the transformation. The well known ERTS-1 MSS image of the Monterey Bay-San Francisco area was transformed using a technique which requires only two intermediate separations. Possible faults were delineated on an overlay of the transformation before referring to geologic maps. The results were quite remarkable in that all large active or recently active faults shown on the latest geologic map of California were interpreted from the image for all, or much, of their length. Perhaps the most interesting result was the Reliz fault. The fault is shown as covered; however, a lineation corresponding to the position of the fault is visible on the image. The usefulness of ERTS image in identifying recently active faults is demonstrable. Although the faults are also visible in the unenhanced image, they are clearly accentuated and more easily mapped on the pseudocolor transformation. Author

N73-28334* Tetra Tech, Inc., Houston, Tex.

DIGITAL INTERACTIVE IMAGE ANALYSIS BY ARRAY PROCESSING

Bruno E. Sabels and Jerry D. Jennings (Geocom, Inc.) In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1189-1203 ERTS

(Paper-113) CSCL 05B

An attempt is made to draw a parallel between the existing geophysical data processing service industries and the emerging earth resources data support requirements. The relationship of seismic data analysis to ERTS data analysis is natural because in either case data is digitally recorded in the same format, resulting from remotely sensed energy which has been reflected, attenuated, shifted and degraded on its path from the source to the receiver. In the seismic case the energy is acoustic, ranging in frequencies from 10 to 75 cps, for which the lithosphere appears semi-transparent. In earth survey remote sensing through the atmosphere, visible and infrared frequency bands are being used. Yet the hardware and software required to process the magnetically recorded data from the two realms of inquiry are identical and similar, respectively. The resulting data products are similar. Author

N73-28335* California Univ., Berkeley. Forestry Remote Sensing Lab.

COMBINING HUMAN AND COMPUTER INTERPRETATION CAPABILITIES TO ANALYZE ERTS IMAGERY

J. D. Nichols In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1205-1210 ERTS

(Paper-114) CSCL 05B

The human photointerpreter and the computer have complementary capabilities that are exploited in a computer-based data analysis system developed at the Forestry Remote Sensing Laboratory, University of California. This system is designed to optimize the process of extracting resource information from ERTS images. The human has the ability to quickly delineate gross differences in land classes, such as wildland, urban, and agriculture on appropriate ERTS images, and to further break these gross classes into meaningful subclasses. The computer, however, can more efficiently analyze point-by-point spectral information and localized textural information which can result in a much more detailed agricultural or wildland classification based on species composition and/or plant association. These human and computer capabilities have been integrated through the use of an inexpensive small scale computer dedicated to the interactive preprocessing of the human inputs and the display of raw ERTS images and computer classified images. The small computer is linked to a large scale computer system wherein the bulk of the statistical work and the automatic point-by-point classification is done. Author

N73-28336* Stanford Research Inst., Menlo Park, Calif.

ANALYSIS OF ERTS IMAGERY USING SPECIAL ELECTRONIC VIEWING/MEASURING EQUIPMENT

William E. Evans and Sidney M. Serebreny In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1211-1218 ref Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21841)

(Paper-115) CSCL 05B

An electronic satellite image analysis console (ESIAC) is being employed to process imagery for use by USGS investigators in several different disciplines studying dynamic hydrologic conditions. The ESIAC provides facilities for storing registered image sequences in a magnetic video disc memory for subsequent recall, enhancement, and animated display in monochrome or color. Quantitative measurements of distances, areas, and brightness profiles can be extracted digitally under operator supervision. Initial results are presented for the display and measurement of snowfield extent, glacier development, sediment plumes from estuary discharge, plays inventory, phreatophyte and other vegetative changes. Author

N73-28337* Kansas Univ. Center for Research, Inc., Lawrence. Space Technology Labs.

COMBINED SPECTRAL AND SPATIAL PROCESSING OF ERTS IMAGERY DATA

Robert M. Haralick and K. Sam Shanmugam In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1219-1228 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-116) CSCL 05B

A procedure for extracting a set of textural features for ERTS-1 MSS data is presented. The textural features were combined with a set of spectral features and were used to develop a classification algorithm for identifying the land use categories of blocks of digital MSS data. The classification algorithm was derived from a training set of 314 blocks and

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tested on a set of 310 blocks. The overall accuracy of the classifier was found to be 83.5% on seven land use categories.
Author

N73-28338* Itek Corp., Lexington, Mass. Optical Systems Div.

TERRAIN TYPE RECOGNITION USING ERTS-1 MSS IMAGES

Nicholas Gramenopoulos *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1229-1241 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-117) CSCL 08B

For the automatic recognition of earth resources from ERTS-1 digital tapes, both multispectral and spatial pattern recognition techniques are important. Recognition of terrain types is based on spatial signatures that become evident by processing small portions of an image through selected algorithms. An investigation of spatial signatures that are applicable to ERTS-1 MSS images is described. Artifacts in the spatial signatures seem to be related to the multispectral scanner. A method for suppressing such artifacts is presented. Finally, results of terrain type recognition for one ERTS-1 image are presented. Author

N73-28339* Pennsylvania State Univ., University Park. Office for Remote Sensing of Earth Resources.

CLASSIFICATION OF ERTS-1 MSS DATA BY CANONICAL ANALYSIS

H. M. Lachowski and F. Y. Borden *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1243-1251 refs ERTS

(Paper-118) CSCL 05B

The objective of canonical analysis is to obtain the maximum separability among a number of categories. The application of canonical analysis was investigated using the merged MSS ERTS-1 data for one area viewed on two dates. The effect of threshold values on classification regions and confusion regions was investigated. Author

N73-28340* Long Island Univ., Greenvale, N.Y. Science Engineering Research Group.

IN SITU SPECTRORADIOMETRIC QUANTIFICATION OF ERTS DATA

Edward F. Yost *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1253-1258 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-119) CSCL 05B

The task of correlating in situ spectral reflectance measurements with ERTS imagery has commenced. A method of additive color analysis of a single multispectral band taken on different dates indicates that ERTS-1 bulk images have sufficient spatial and spectral fidelity to show indications of the presence of soil moisture in desert playas and changes in soil moisture with time. The chain of causality between soil moisture, in situ spectral reflectance, and ERTS multispectral scanner image density remains to be established during the subsequent phases of this study. Author

N73-28365* Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.

DCP-COLLECTED ABSOLUTE TARGET REFLECTANCE SIGNATURES ASSIST ACCURATE INTERPRETATION OF ERTS-1 IMAGERY

Frederick P. Weber *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1513-1522 Original contains imagery. Original photography may be purchased from the EROS Data

Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
CSCL 05B

Data collection platforms (DCP's) are being used at a Black Hills, South Dakota, test site (MMC 226A) to record radiometric measurements needed to determine solar and atmospheric parameters that affect ERTS-1 multispectral scanner radiance measurements. A total of 72 channels of analog data transmitted from an unattended ground truth site via three DCP's at least six times a day. The system has operated with only minor problems since September, sending forth daily measurements of biophysical responses and atmospheric conditions. Comparisons of scene radiance data calculated from ERTS images with that measured on the ground show the image-measured values to be 35 percent higher for the green channel and 20 percent higher for the red channel for the same scene targets. Radiance values for channels 6 and 7 are nearly the same from the ground data and from the imagery. Author

N73-28380* Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.

DIGITAL DATA PROCESSING OF ERTS-1 IMAGERY OF DELAWARE BAY

Alfred C. Conrod *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1641-1647 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

CSCL 05B

A user-oriented Earth Resources Data Center is in operation at Bendix Aerospace, which is capable of automatically producing classification imagery and thematic maps from ERTS computer compatible tapes. The ERDC is now being used to process ERTS-1 data under a subcontract from the University of Delaware. ERTS coverage of Delaware Bay has been processed to produce classification imagery of water masses in the bay, and a map of all land-water boundaries along the shoreline including wetlands and inland lakes. Imagery, the user's video monitor color display, the data processing facility, and methodology are described. Author

N73-28381* Geological Survey, Flagstaff, Ariz. Museum of Northern Arizona.

THE USE OF PHOTOGRAPHIC METHODS IN CONTRAST ENHANCEMENT OF ERTS-1 IMAGES

Lawrence F. Harris *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1649-1659 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

CSCL 14E

The contrast of ERTS 70mm positive images can be enhanced to varying degrees by rephotographing the images with different types of negative films, and by overdeveloping the films with different developers. A combination of high contrast copy film (Kodak 5069) and a high energy developer (Kodak D-11) yields high contrast. Still greater contrast may be obtained by using a film of higher contrast capability and a developer of higher energy capability. Contrast can also be enhanced in the printing process with the use of highcontrast photographic papers, or with the use of polycontrast photographic paper and filters. Contrast enhancement by photocopying delineates topographic boundaries and may aid in the objective measurement of topographic parameters. Author

N73-28382* Earth Satellite Corp., Berkeley, Calif.

PRECISION ANNOTATION OF PREDETERMINED PRIMARY SAMPLING UNITS ON ERTS-1 MSS IMAGES

Jan W. VanRoessel and Philip G. Langley *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1661-1673 refs Original contains imagery. Original photography may be

purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

CSCL 05B

Resectioning programs were developed for projecting the boundary corners of sample units, management units, and counties into U2 RC-10 and ERTS-1 MSS images. The technique used includes corrections for earth curvature, terrain elevation, and MSS distortions. The minimum standard error obtained was about 0.15 mm or 150 meters on the ground. This technique now makes it possible to include land ownership as an integral part of forest resource sampling plans using ERTS imagery. Author

N73-28392* Purdue Univ., Lafayette, Ind. **IDENTIFICATION AND MAPPING OF SOILS, VEGETATION, AND WATER RESOURCES OF LYNN COUNTY, TEXAS, BY COMPUTER ANALYSIS OF ERTS MSS DATA**

Marion F. Baumgardner, Steven J. Kristof, and James A. Henderson, Jr. *In* NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 2 May 1973 p 17-30 An earlier version of this paper was published in Volume 1, pages 213-222 Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

CSCL 08B

Results of the analysis and interpretation of ERTS multispectral data obtained over Lynn County, Texas, are presented. The test site was chosen because it embodies a variety of problems associated with the development and management of agricultural resources in the Southern Great Plains. Lynn County is one of ten counties in a larger test site centering around Lubbock, Texas. The purpose of this study is to examine the utility of ERTS data in identifying, characterizing, and mapping soils, vegetation, and water resources in this semiarid region. Successful application of multispectral remote sensing and machine-processing techniques to arid and semiarid land-management problems will provide valuable new tools for the more than one-third of the world's lands lying in arid-semiarid regions.

Author

N73-28412* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

INTERPRETATION TECHNIQUES DEVELOPMENT

William L. Alford *In its* Symp. on Significant Results obtained from the ERTS-1, Vol. 3 May 1973 p 83-94 refs ERTS

CSCL 05B

The processes, algorithms and procedures for extraction and interpretation of ERTS-1 data are discussed. Analysis of data acquired temporally is possible through geometric correction, correlation, and registration techniques. The powerful techniques in image enhancement developed for the lunar and planetary programs are valuable for Earth Resources Survey programs. There is evidence that both optical and digital methods of spatial information extraction can provide valuable sources of data information the ERTS system. The techniques available, even for a limited number of bands and limited resolution can be effectively used to extract much of the information required by resource managers.

Author

N73-28414* Cornell Univ., Ithaca, N.Y. Dept. of Natural Resources.

EVALUATION OF SATELLITE IMAGERY AS AN INFORMATION SERVICE FOR INVESTIGATING LAND USE AND NATURAL RESOURCES (SKYLAB) Progress Report, 1 May - 31 Jul. 1973

Ernest E. Hardy, Principal Investigator 31 Jul. 1973 1 p EREP

(Contract NAS9-13364)

(E73-10829; NASA-CR-133334) Avail: NTIS HC \$3.00 CSCL 08B

N73-28430* TRW Systems Group, Redondo Beach, Calif. **ERTS IMAGE DATA COMPRESSION TECHNIQUE EVALUATION Monthly Progress Report, period ending 1 Aug. 1973**

Donald J. Spencer, Principal Investigator and Curtis L. May 8 Aug. 1973 2 p ERTS
(Contract NAS5-21746)
(E73-10853; NASA-CR-133441) Avail: NTIS HC \$3.00 CSCL 05B

N73-28431* Tennessee Univ., Knoxville. Dept. of Electrical Engineering.

ERTS-A IMAGERY INTERPRETATION TECHNIQUES IN THE TENNESSEE VALLEY Progress Report, 25 May - 25 Jul. 1973

Robert E. Bodenheimer, Principal Investigator 4 Aug. 1973 2 p ERTS

(Contract NAS5-21875)

(E73-10854; NASA-CR-133442) Avail: NTIS HC \$3.00 CSCL 05B

N73-28432* Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.

MACHINE PROCESSING OF ERTS AND GROUND TRUTH DATA

Robert H. Rogers, Principal Investigator and Keith Peacock 7 Aug. 1973 14 p refs Proposed for presentation at Conf. on Machine Processing of Remotely Sensed Data, Lafayette, Ind., 16-18 Oct. 1973; sponsored by Purdue Univ. ERTS

(Contract NAS5-21863)

(E73-10855; NASA-CR-133443) Avail: NTIS HC \$3.00 CSCL 05B

The author has identified the following significant results. Results achieved by ERTS-Atmospheric Experiment PR303, whose objective is to establish a radiometric calibration technique, are reported. This technique, which determines and removes solar and atmospheric parameters that degrade the radiometric fidelity of ERTS-1 data, transforms the ERTS-1 sensor radiance measurements to absolute target reflectance signatures. A radiant power measuring instrument and its use in determining atmospheric parameters needed for ground truth are discussed. The procedures used and results achieved in machine processing ERTS-1 computer-compatible tapes and atmospheric parameters to obtain target reflectance are reviewed.

N73-29210* Environmental Research Inst. of Michigan, Ann Arbor.

DEVELOPING PROCESSING TECHNIQUES FOR SKYLAB DATA Monthly Report, 1-31 Jul. 1973

Richard F. Nalepka, Principal Investigator 3 Aug. 1973 1 p EREP

(Contract NAS9-13280)

(E73-10859; NASA-CR-133447; MR-5) Avail: NTIS HC \$3.00 CSCL 05B

N73-29211* Environmental Research Inst. of Michigan, Ann Arbor.

DEVELOPING PROCESSING TECHNIQUES FOR SKYLAB DATA Monthly Report, 1-30 Jun. 1973

Richard F. Nalepka, Principal Investigator 20 Jul. 1973 1 p EREP

(Contract NAS9-13280)

(E73-10860; NASA-CR-133448; MR-4) Avail: NTIS HC \$3.00 CSCL 05B

N73-29215* Oceanographic Services, Inc., Santa Barbara, Calif.

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ACQUISITION AND ANALYSIS OF COASTAL GROUND TRUTH DATA FOR CORRELATION WITH ERTS-1 IMAGERY Bimonthly Progress Report, 2 Jun. - 2 Aug. 1973

William A. Anikouchine, Principal Investigator 9 Aug. 1973 4 p ERTS
(Contract NAS5-21877)
(E73-10864; NASA-CR-133453; MPR-4) Avail: NTIS HC \$3.00 CSCL 08J

The author has identified the following significant results. Data obtained from cruises in Santa Monica Bay and Santa Barbara Channel appear to be consistent with conditions observed at each sample site. Further attempts to correlate ground truth data with MSS data will be deferred until CCT enhancement techniques are perfected.

N73-29222*# Environmental Research Inst. of Michigan, Ann Arbor.

DETERMINATION OF THE EARTH'S AEROSOL ALBEDO USING SKYLAB DATA Quarterly Report, 8 Mar. - 8 Jun. 1973

Robert E. Turner, Principal Investigator 18 Jun. 1973 2 p EREP
(Contract NAS9-13279)
(E73-10871; NASA-CR-133384; QR-1) Avail: NTIS HC \$3.00 CSCL 03B

N73-29229*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

AN INTERDISCIPLINARY ANALYSIS OF MULTISPECTRAL SATELLITE DATA FOR SELECTED COVER TYPES IN THE COLORADO MOUNTAINS, USING AUTOMATIC DATA PROCESSING TECHNIQUES Monthly Progress Report, May 1973

Roger M. Hoffer, Principal Investigator 18 May 1973 2 p EREP
(Contract NAS9-13380)
(E73-10878; NASA-CR-133495) Avail: NTIS HC \$3.00 CSCL 08B

N73-29230*# South Dakota State Univ., Brookings. Remote Sensing Inst.

[ACQUISITION AND PROCESSING OF SKYLAB DATA] Monthly Report, period ending 1 Jul. 1973

Victor I. Myers, Principal Investigator 1 Jul. 1973 3 p EREP
(Contract NAS9-13337)
(E73-10878; NASA-CR-133498) Avail: NTIS HC \$3.00 CSCL 05B

N73-29261*# South Dakota State Univ., Brookings. Remote Sensing Inst.

[COLLECTION AND PROCESSING OF SKYLAB DATA] Monthly Progress Report, period ending 1 Aug. 1973

Victor I. Myers, Principal Investigator 1 Aug. 1973 2 p EREP
(Contract NAS9-13337)
(E73-10912; NASA-CR-133569) Avail: NTIS HC \$3.00 CSCL 05B

N73-29263*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

AN INTERDISCIPLINARY ANALYSIS OF MULTISPECTRAL SATELLITE DATA FOR SELECTED COVER TYPES IN THE COLORADO MOUNTAINS, USING AUTOMATIC DATA PROCESSING TECHNIQUES Monthly Progress Report, Jul. 1973

Roger M. Hoffer, Principal Investigator Jul. 1973 2 p EREP
(Contract NAS9-13380)
(E73-10914; NASA-CR-133571) Avail: NTIS HC \$3.00 CSCL 08F

N73-29366*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

GENERATION AND PHYSICAL CHARACTERISTICS OF THE ERTS MSS SYSTEM CORRECTED COMPUTER COMPATIBLE TAPES

Valerie L. Thomas Jul. 1973 59 p
(NASA-TM-X-70426; X-563-73-206) Avail: NTIS HC \$5.00 CSCL 05B

The generation and format are discussed of the ERTS system corrected multispectral scanner computer compatible tapes. The discussion includes spacecraft sensors, scene characteristics, data transmission, and conversion of data to computer compatible tapes at the NASA Data Processing Facility. Geometric and radiometric corrections, tape formats, and the physical characteristics of the tapes are also included. Author

N73-30273*# Earth Satellite Corp., Washington, D.C.

FACILITATING THE EXPLOITATION OF ERTS IMAGERY USING SNOW ENHANCEMENT TECHNIQUES Bimonthly Progress Report, 1 Jul. - 31 Aug. 1973

Frank J. Wobber, Kenneth Martin, Principal Investigators, Roger Amato, and Thomas Leshendok 30 Aug. 1973 15 p ERTS
(Contract NAS5-21744)
(E73-10930; NASA-CR-133587) Avail: NTIS HC \$3.00 CSCL 08L

The author has identified the following significant results. Comparative analysis of snow-free and snow-covered imagery of the New England Test Area has resulted in a larger number of lineaments mapped from snow-covered imagery in three out of four sets of comparative imagery. Analysts unfamiliar with the New England Test Area were utilized; the quality of imagery was independently judged to be uniform. In all image sets, a greater total length of lineaments was mapped with the snow-covered imagery. The value of this technique for fracture mapping in areas with thick soil cover is suggested. A number of potentially useful environmental applications of snow enhancement related to such areas as mining, land use, and hydrology have been identified.

N73-30289*# Science Applications, Inc., La Jolla, Calif.

DETERMINATION OF AEROSOL CONTENT IN THE ATMOSPHERE FROM ERTS-1 DATA Progress Report, 7 Jul. - 6 Sep. 1973

Claus B. Ludwig and Michael Griggs, Principal Investigators 7 Sep. 1973 11 p ERTS
(Contract NAS5-21860)
(E73-10947; NASA-CR-133623; PR-6) Avail: NTIS HC \$3.00 CSCL 04A

The author has identified the following significant results. Useful empirical relationships between apparent contrast at the Salton Sea/desert test site and the aerosol content of the atmosphere have been found for MSS 4, 5, and 6. This provides another technique to measure the atmospheric aerosol content, in addition to the method of measuring radiance over water surfaces previously reported. Analysis of desert data has shown, as predicted by theory, that the radiance over high albedo surfaces is insensitive to changes in the aerosol content of the atmosphere.

N73-30290*# International Business Machines Corp., Gaithersburg, Md. Federal Systems Center.

ALL DIGITAL PRECISION PROCESSING OF ERTS IMAGES Progress Report, 1 Jul. - 31 Aug. 1973

Ralph Bernstein, Principal Investigator 7 Sep. 1973 4 p ERTS
(Contract NAS5-21716)
(E73-10948; NASA-CR-133624) Avail: NTIS HC \$3.00 CSCL 05B

N73-30296*# Geological Survey, Washington, D.C.
**ANALYSIS STUDY OF MULTISPECTRAL DATA, ERTS-A,
 FROM AN AREA IN WEST PAKISTAN** Progress Report.
 1 Jan. - 30 Jun. 1973

Robert G. Schmidt, Principal Investigator 19 Jul. 1973 5 p
 ERTS

(Contract NASA Order S-70243-AG)

(E73-10954; NASA-CR-133630) Avail: NTIS HC \$3.00 CSCI
 05B

The author has identified the following significant results. Geomorphic features related to a known porphyry copper deposit at Saindak, western Chagai District, Pakistan, are easily distinguished on ERTS-1 images. No new prospecting sites were recognized on the basis of the images alone, but new information from the images was used in conjunction with known geology to evaluate two previously known speculative areas and to suggest one additional one. The study showed that Saindak-type deposits are less likely in some extensive areas of the Chagai District than formerly believed. The Saindak deposit is in an area of relatively soft folded sedimentary and volcanic rocks. The deposit is characterized by a linear zone of easily eroded sulfide-rich rock surrounded by a resistant rim of hornfels and propylitically altered rock. Both this rim and the central sulfide-rich valley are conspicuous features on the images. Swarms of dikes are probably useful for distinguishing real rims from other resistant rock types, but there is no expression of them on the image, although they are easily seen on aerial photographs of the Saindak rim. During field mapping, patches of strong red and yellow hue related to the mineral natrojarosite were noted in the central valley. Attempts to detect a color anomaly using simple false color composites were not successful.

N73-30301*# TRW Systems Group, Redondo Beach, Calif.
**ERTS IMAGE DATA COMPRESSION TECHNIQUE EVALUA-
 TION** Monthly Progress Report, period ending 1 Sep. 1973
 Donald J. Spencer, Principal Investigator 6 Sep. 1973 1 p
 ERTS

(Contract NAS5-21746)

(E73-10959; NASA-CR-133635) Avail: NTIS HC \$3.00 CSCI
 05B

N73-30305*# TRW Systems Group, Redondo Beach, Calif.
**EVALUATION OF DIGITAL CORRECTION TECHNIQUES
 FOR ERTS IMAGES** Bimonthly Progress Report, Jul. - Aug.
 1973

John E. Taber, Principal Investigator and S. S. Rifman Aug.
 1973 4 p Original contains imagery. Original photography
 may be purchased from the EROS Data Center, 10th and Dakota
 Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21814)

(E73-10963; NASA-CR-133647) Avail: NTIS HC \$3.00 CSCI
 05B

N73-30309*# Long Island Univ., Greenvale, N.Y. Science
 Engineering Research Group:
**IN SITU SPECTRORADIOMETRIC QUANTIFICATION OF
 ERTS DATA** Progress Report, 15 Jun. - 15 Aug. 1973

Edward Yost, Principal Investigator 15 Aug. 1973 1 p ERTS
 (Contract NAS5-21793)

(E73-10967; NASA-CR-133746) Avail: NTIS HC \$3.00 CSCI
 05B

N73-30314*# Kansas Univ. Center for Research, Inc., Law-
 rence.

PRECIPITATION PATTERN ON ERTS-1 IMAGE

S. A. Morain, Principal Investigator and Donald L. Williams
 10 Apr. 1973 3 p ref Original contains imagery. Original
 photography may be purchased from the EROS Data Center,
 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21822)

(E73-10975; NASA-CR-133754) Avail: NTIS HC \$3.00 CSCI
 04B

The author has identified the following significant results. A precipitation pattern in west central Kansas was detected on an MSS image acquired 22 September 1972. Good correspondence was found between the interpolated one-inch isohyet and the apparent precipitation boundary in the image.

N73-30316*# Kansas Univ. Center for Research, Inc., Law-
 rence.

**IDENTIFICATION OF BASIC CLOUD TYPES FROM ERTS
 IMAGERY**

Stanley A. Morain, Principal Investigator and Donald L. Williams
 9 May 1973 6 p Original contains imagery. Original
 photography may be purchased from the EROS Data Center,
 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
 (Contract NAS5-21822)

(E73-10977; NASA-CR-133756) Avail: NTIS HC \$3.00 CSCI
 04B

The author has identified the following significant results. It was found that seven basic cloud types could be detected from ERTS-1 imagery. Each type exhibited characteristics that made them distinct. Suitable examples of each type were chosen, described, and a cloud identification item-index key prepared.

N73-30356# Plessey Co., Ltd., Havant (England). Electronics
 Research Lab.

**MULTISPECTRAL SCANNING SYSTEMS AND THEIR
 POTENTIAL APPLICATION TO EARTH RESOURCE SUR-
 VEYS. VOLUME 3: DATA PROCESSING**

Q. S. Earl and G. Taylor Apr. 1972 271 p refs

(Contract ESTEC-1673/72-EL)

(ERL/R-245; ESRO-CR(P)-233) Avail: NTIS HC \$15.75

The automatic processes which serve to make multispectral scanned (MSS) data useful are discussed. The assembly of data from the sensors in a usable form permitting its selection by and distribution to users is described. The means for the exchange of pictures and reference to pictures between the system and user (i.e. image-handling systems) are described and possible developments in the technology are discussed. A statement of operations the user can have performed on MSS data is given together with possible operations and interventions by the user. The computing methods and possible special purpose equipment are discussed together with the integration of the processes in a working system.

ESRO

N73-31125 Kansas Univ., Lawrence.

IMAGE ANALYSIS SYSTEMS Ph.D. Thesis

George William Dalke 1972 223 p

Avail: Univ. Microfilms Order No. 73-11874

A multi-image photo-interpretation system was designed, constructed, and used to process several types of photographs. The equipment consists of four synchronized flying spot scanners, a color display, and devices that perform the following processing functions: (1) brightness and contrast enhancement, (2) density level slice, (3) edge enhancement, (4) area measurement of sliced levels, (5) density probability distributions, (6) line scan modulation and display, (7) single line selection and profile display, (8) linear combination of multiple images and color display, (9) simultaneous enhancement and calibration, and (10) classification by multi-image signature detection. Test sites were set up, ground truth and imagery were collected, and various processing functions were tested. The multi-image classification experiments used four color separations made from an Ektachrome-Infrared image.

Dissert. Abstr.

N73-31290*# Utah Univ., Salt Lake City. Dept. of Geological
 and Geophysical Science.

PHOTOINTERPRETATION OF SKYLAB 2 MULTISPECTRAL

07 DATA PROCESSING AND DISTRIBUTION SYSTEMS

CAMERA (S-190A) DATA: ADVANCE REPORT OF SIGNIFICANT RESULTS

Mead L. Jensen, Principal Investigator Sep. 1973 2 p EREP
(Contract NAS9-13322)
(E73-10983; NASA-CR-133762) Avail: NTIS HC \$3.00 CSDL
05B

The author has identified the following significant results. A significant and possible major economic example of the practical value of Skylab photographs was provided by locating on Skylab Camera Station Number 4, frame 010, SL-2, an area of exposures of limestone rocks which were thought to be completely covered by volcanic rocks based upon prior mapping. The area is located less than 12 miles north of the Ruth porphyry copper deposit, White Pine County, Nevada. This is a major copper producing open pit mine owned by Kennecott Copper Corporation. Geophysical maps consisting of gravity and aeromagnetic studies have been published indicating three large positive magnetic anomalies located at the Ruth ore deposits, the Ward Mountain, not a mineralized area, and in the area previously thought to be completely covered by post-ore volcanics. Skylab photos indicate, however, that erosion has removed volcanic cover in specific sites sufficient to expose the underlying older rocks suggesting, therefore, that the volcanic rocks may not be the cause of the aeromagnetic anomaly. Field studies have verified the initial interpretations made from the Skylab photos. The potential significance of this study is that the large positive aeromagnetic anomaly suggests the presence of cooled and solidified magma below the anomalies, in which ore-bearing solutions may have been derived forming possible large ore deposits.

N73-31298* Smithsonian Astrophysical Observatory, Cambridge, Mass.

STUDIES OF IMAGES OF SHORT-LIVED EVENTS USING ERTS DATA Progress Report, 1 May - 30 Jun. 1973

William A. Deutschman, Principal Investigator 30 Jun. 1973
1 p ERTS
(Contract NAS5-21858)
(E73-10990; NASA-CR-133769) Avail: NTIS HC \$3.00 CSDL
14E

The author has identified the following significant results. Significant results are the continued detection of short-lived events. The following have been detected and analyzed: forest fires, oil spills, vegetation damage, volcanoes, storm ridges, and earthquakes. It is hoped that the Mississippi River flood scenes will arrive shortly and then floods be added to the list of identified short-lived events.

N73-31307* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

AN INTERDISCIPLINARY ANALYSIS OF MULTISPECTRAL SATELLITE DATA FOR SELECTED COVER TYPES IN THE COLORADO MOUNTAINS, USING AUTOMATIC DATA PROCESSING TECHNIQUES Monthly Progress Report, Aug. 1973

Ronger M. Hoffer, Principal Investigator 18 Sep. 1973 9 p EREP
(Contract NAS9-13380)
(E73-11002; NASA-CR-133785) Avail: NTIS HC \$3.00 CSDL
08H

N73-31312* Army Engineer Waterways Experiment Station, Vicksburg, Miss.

A TECHNIQUE FOR INTERPRETATION OF MULTISPECTRAL REMOTE SENSOR DATA

A. N. Williamson 19 Sep. 1973 15 p Presented at the Am. Soc. of Photogrammetry Symp. on Remote Sensing in Oceanography, Orlando, Fla., 2-5 Oct. 1973 Sponsored by NASA ERTS
(E73-11007; NASA-CR-133800) Avail: NTIS HC \$3.00 CSDL
05B

The author has identified the following significant results. The U.S. Army Engineer Waterways Experiment Station is engaged

in a study to detect from ERTS-1 satellite data alterations to the absorption and scattering properties caused by movement of suspended particles and solutes in selected areas of the Chesapeake Bay and to correlate the data to determine the feasibility of delineating flow patterns, flushing action of the estuary, and sediment and pollutant dispersion. As a part of this study, ADP techniques have been developed that permit automatic interpretation of data from any multispectral remote sensor with computer systems which have limited memory capacity and computing speed. The multispectral remote sensor is considered as a reflectance spectrophotometer. The data which define the spectral reflectance characteristics of a scene are scanned pixel by pixel. Each pixel whose spectral reflectance matches a reference spectrum is identified, and the results are shown in a map that identifies the locations where spectrum matches were detected and spectrum that was matched. The interpretation technique is described and an example of interpreted data from ERTS-1 is presented.

N73-31323*# TRW Systems Group, Redondo Beach, Calif. EVALUATION OF DIGITAL CORRECTION TECHNIQUES FOR ERTS IMAGES Semiannual Report, Mar. - Aug. 1973

Samuel S. Rifman, Principal Investigator Sep. 1973 13 p
Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(Contract NAS5-21814)
(E73-11019; NASA-CR-133816; TRW-20634-6002-RU-00)
Avail: NTIS HC \$3.00 CSDL 14E

N73-31325*# Oregon State Univ., Corvallis. Rangeland Resources Program.

INVENTORY AND MONITORING OF NATURAL VEGETATION AND RELATED RESOURCES IN AN ARID ENVIRONMENT: A COMPARATIVE EVALUATION OF ERTS-1 IMAGERY Progress Report, 1 Mar. - 31 Aug. 1973

Barry J. Schrumpp, Principal Investigator, James R. Johnson, David A. Mouat, and William T. Pyott 20 Sep. 1973 14 p refs
ERTS
(Contract NAS5-21831)
(E73-11021; NASA-CR-133818) Avail: NTIS HC \$3.00 CSDL
08F

The author has identified the following significant results. A comparative evaluation of an ERTS-1 MSS color reconstitution and an Apollo 6 and Gemini 4 color photograph for information content was conducted. A greater variety of image detail was indicated for the Apollo 6 imagery. A study of terrain feature variable-vegetation relationships has been concluded. However, there were no substantial differences among space photo types when macrorelief classes were interpreted. Vegetation distribution is influenced in varying degrees by characteristics of the terrain, some of which are quite apparent on ERTS-1 imagery and, therefore, provide the means for inferring possible vegetation types for a specified location. Spectral signatures have been determined for some natural vegetation systems from the ERTS-1 MSS data. Those signatures have been used to classify ERTS-1 data for a portion of the study area. Work continues on multistage sampling for natural vegetation, terrain feature identification of ERTS-1 photographs, plant phenology, and spectral signature studies.

N73-31326*# Wyoming Univ., Laramie. Dept. of Geology. ANALYSIS OF ERTS-1 IMAGERY AND ITS APPLICATION TO EVALUATION OF WYOMING'S NATURAL RESOURCES Progress Report, Jul. - Aug. 1973

Ronald W. Marrs 15 Sep. 1973 10 p ERTS
(Contract NAS5-21799)
(E73-11022; NASA-CR-133819; ERTS-1-1-73D) Avail: NTIS
HC \$3.00 CSDL 08G

The author has identified the following significant results. A summary of the significant results of the studies completed during the July-August, 1973 period includes: (1) ERTS-1 image

brightness contrasts can be related to important contrasts in rangeland and forest vegetation communities of the Laramie Basin. (2) Stereoscopic viewing is essential for correct structural interpretation in outcrop patterns in some areas. (3) Complex fracture patterns which may have exerted a controlling influence on intrusive activity in the Absaroka Mountains can be mapped from ERTS. (4) Volcanic lithologies of the Yellowstone region are often differentiated on the basis of their textures, and cannot be successfully mapped by photogeologic interpretation of ERTS-1 imagery. Ground spectral readings confirm a general lack of contrast between these lithologies in the four ERTS-1 MSS bands. (5) Major dune fields can be recognized and defined from ERTS-1 image interpretations and recognition of differences in stabilizing plant communities (some of which may be mappable from ERTS-1) yields information about migration history of the dune fields.

N73-31344*# Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.
STUDY OF ATMOSPHERIC EFFECTS IN SKYLAB DATA
 Quarterly Report, 8 Mar. - 31 May 1973
 Frederick J. Thomson, Principal Investigator 25 Jun. 1973 2 p
 EREP
 (Contract NAS9-13272)
 (E73-11043; NASA-CR-133928; QR-1) Avail: NTIS HC \$3.00 CSDL 04A

report.

N73-31348*# Rice Univ., Houston, Tex. Inst. for Computer Services and Applications.
PHASE 1 OF THE EARTH RESOURCES DATA ANALYSIS PROGRAM Final Report, Jun. 1972 - May 1973
 Jun. 1973 9 p
 (Contract NAS9-12776)
 (NASA-CR-133982) Avail: NTIS HC \$3.00 CSDL 05B
 Research completed in the Earth Resources Data Analysis Program is discussed along with recommendations for future study. Projects discussed include use of the Cholesky decomposition in feature selection and classification algorithms; optimal feature selection and extraction, probability density estimation and nonparametric classifiers; use of spatial information in classification; and model for crop row reflectance. The installation of LARSYS on the ICASA's IBM 370/155 is discussed, and a list of technical reports is included. K.M.M.

N73-32224*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
STUDIES OF IMAGES OF SHORT-LIVED EVENTS USING ERTS DATA Progress Report, 1 Mar. - 30 Aug. 1973
 William A. Deutschman, Principal Investigator Oct. 1973 5 p
 ERTS
 (Contract NAS5-21858)
 (E73-11048; NASA-CR-133869) Avail: NTIS HC \$3.00 CSDL 08E

N73-32233*# National Environmental Satellite Service, Washington, D.C.
A CLOUD PHYSICS INVESTIGATION UTILIZING SKYLAB DATA Quarterly Progress Report, Jul. - Sep. 1973
 John Alishouse, Herbert Jacobowitz, and David Wark, Principal Investigators 3 Oct. 1973 5 p refs EREP
 (NASA Order T-4715-B)
 (E73-11057; NASA-CR-133947; QPR-2) Avail: NTIS HC \$3.00 CSDL 04B

N73-32253*# Environmental Research Inst. of Michigan, Ann Arbor.
DEVELOPING PROCESSING TECHNIQUES FOR SKYLAB

DATA Monthly Progress Report, Aug. 1973
 Richard F. Nalepka and William A. Malila, Principal Investigators
 28 Sep. 1973 2 p EREP
 (Contract NAS9-13280)
 (E73-11078; NASA-CR-135547; MPR-6) Avail: NTIS \$3.00 CSDL 05B

N73-32255*# Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.
DETERMINATION OF THE EARTH'S AEROSOL ALBEDO USING SKYLAB DATA Quarterly Report, 8 Jun. - 31 Aug. 1973
 Robert E. Turner, Principal Investigator 25 Sep. 1973 2 p
 EREP
 (Contract NAS9-13279)
 (E73-11080; NASA-CR-135549; Rept-102200-5-L; QR-2) Avail: NTIS HC \$3.00 CSDL 03B

N73-32283*# Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.
STUDY OF ATMOSPHERIC EFFECTS IN SKYLAB DATA
 Frederick J. Thomson, Principal Investigator 8 Oct. 1973 3 p
 EREP
 (Contract NAS9-13272)
 (E73-11118; NASA-CR-135621; ERIM-101700-8-L; QPR-2) Avail: NTIS HC \$3.00 CSDL 05B

N73-33254*# Geological Survey, Washington, D.C.
ANALYSIS STUDY OF MULTISPECTRAL DATA, ERTS-A, FROM AN AREA IN WEST PAKISTAN Progress Report,
 1 Jul. - 31 Aug. 1973
 Robert G. Schmidt, Principal Investigator 25 Sep. 1973 2 p
 ERTS
 (NASA Order S-70243-AG)
 (E73-11097; NASA-CR-135566) Avail: NTIS HC \$3.00 CSDL 05B

N73-33260*# Pennsylvania State Univ., University Park. Space Science and Engineering Lab.
COMPARISON OF PREPROCESSING AND CLASSIFICATION TECHNIQUES AS APPLIED TO MULTISPECTRAL SCANNER DATA Interim Report
 George J. McMurtry, Gary W. Petersen, Principal Investigators, and J. R. Hoosty May 1973 4 p ref ERTS
 (Contract NAS5-23133)
 (E73-11103; NASA-CR-135572; ORSER-SSEL-TR-15-73) Avail: NTIS HC \$3.00 CSDL 14E

N73-33261*# Pennsylvania State Univ., University Park. Space Science and Engineering Lab.
CANONICAL ANALYSIS APPLIED TO THE INTERPRETATION OF MULTISPECTRAL SCANNER DATA Interim Report
 George J. McMurtry, Gary W. Petersen, Principal Investigators, H. M. Lachowski, and F. Y. Borden May 1973 3 p ref ERTS
 (Contract NAS5-23133)
 (E73-11104; NASA-CR-135573; ORSER-SSEL-TR-17-73) Avail: NTIS HC \$3.00 CSDL 08M

N73-33262*# Pennsylvania State Univ., University Park. Space Science and Engineering Lab.
PROCESSING OF REMOTE SENSING DATA Interim Report
 George J. McMurtry, Gary W. Petersen, Principal Investigators, S. J. Chung, and N. B. Bolling May 1973 20 p refs ERTS
 (Contract NAS5-23133)
 (E73-11105; NASA-CR-135574; ORSER-SSEL-TR-19-73) Avail:

07 DATA PROCESSING AND DISTRIBUTION SYSTEMS

NTIS HC \$3.00 CSCL 14E

N73-33263*# Pennsylvania State Univ., University Park. Office for Remote Sensing of Earth Resources (ORSER).

DEVELOPMENT OF THE HYBRID APPROACH TO DATA PROCESSING Interim Report

George J. McMurtry, Gary W. Petersen, Principal Investigators, H. A. Weeden, F. Y. Borden, D. N. Applegate, and N. B. Bolling May 1973 17 p ref ERTS (Contract NAS5-23133)

(E73-11106; NASA-CR-135576; ORSER-SSEL-TR-13-73) Avail: NTIS HC \$3.00 CSCL 05B

N73-33265*# Pennsylvania State Univ., University Park. Space Science and Engineering Lab.

CORRECTION OF BANDING IN MSS DIGITAL DATA Interim Report

George J. McMurtry, Gary W. Petersen, Principal Investigators, and F. Y. Borden May 1973 2 p ref ERTS (Contract NAS5-23133)

(E73-11108; NASA-CR-135577; ORSER-SSEL-TR-22-73) Avail: NTIS HC \$3.00 CSCL 05B

N73-33273*# Pennsylvania State Univ., University Park. Office for Remote Sensing of Earth Resources (ORSER).

STORAGE AND RETRIEVAL OF ERTS AND UNDERFLIGHT IMAGERY Interim Report

George J. McMurtry, Gary W. Petersen, Principal Investigators, and N. B. Bolling May 1973 10 p ref Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-23133)

(E73-11116; NASA-CR-135585; ORSER-SSEL-TR-12-73) Avail: NTIS HC \$3.00 CSCL 05B

N73-33277*# Lund Univ. (Sweden). Dept. of Physical Geography.

EVALUATION OF DATA UTILITY FOR EARTH SCIENCES FROM METHODOLOGICAL POINT OF VIEW Progress Report, Feb. - Aug. 1973

Harald Svensson, Principal Investigator 10 Oct. 1973 8 p refs Sponsored by NASA ERTS

(E73-11122; NASA-CR-135660) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. A very distinct line representing the Ra-substage of the last deglaciation period is observable around the outer parts of the Oslo fjord. The moraine line is also traceable in some parts of the forest district on the Swedish side of the border forming part of the Central Swedish End Moraines. In the area of Lake Vanern to the southeast, the line is then again more distinct, partly due to the cultivation pattern. Outside the Central Swedish Moraine Line and nearer to the coast another not so distinct moraine line could be observed running NNW-SSE. This line crosses the coastline before reaching the Oslo fjord. Probably the moraine deposits on some outer islands in the fjord constitute part of this older moraine line. The study will be extended to districts of southern Sweden, where old moraine lines of the last deglaciation period are incompletely mapped.

N73-33287*# Purdue Univ., Lafayette, Ind. Lab. for Application of Remote Sensing.

AN INTERDISCIPLINARY ANALYSIS OF MULTISPECTRAL SATELLITE DATA FOR SELECTED COVER TYPES IN THE COLORADO MOUNTAINS, USING AUTOMATIC DATA PROCESSING TECHNIQUES Monthly Progress Report, Sep.

1973

Roger M. Hoffer, Principal Investigator Sep. 1973 6 p EREP (Contract NAS9-13380)

(E73-11132; NASA-CR-135679) Avail: NTIS HC \$3.00 CSCL 08F

N73-33293*# Boeing Co., Seattle, Wash.

QUANTITATIVE DETERMINATION OF STRATOSPHERIC Monthly Report, Sep. 1973

David L. Tingey, Principal Investigator Sep. 1973 1 p EREP (Contract NAS9-13303)

(E73-11138; NASA-CR-135689) Avail: NTIS HC \$3.00 CSCL 04A

N73-33297*# Environmental Research Inst. of Michigan, Ann Arbor.

DEVELOPING PROCESSING TECHNIQUES FOR SKYLAB DATA Monthly Progress Report, Sep. 1973

Richard F. Nalepka and William A. Malila, Principal Investigators 9 Oct. 1973 3 p EREP

(Contract NAS9-13280)

(E73-11142; NASA-CR-135701; ERIM-101900-16-L; MPR-7) Avail: NTIS HC \$3.00 CSCL 05B

N73-33306*# Michigan State Univ., East Lansing.

[GROUND TRUTH ACQUISITION] Investigation of Skylab Data. Monthly Progress Report, Sep. 1973

Lester V. Manderscheid, Principal Investigator Sep. 1973 2 p EREP

(Contract NAS9-13332)

(E73-11152; NASA-CR-135740) Avail: NTIS HC \$3.00 CSCL 05B

08

INSTRUMENTATION AND SENSORS

Includes data acquisition and camera systems and remote sensors.

A70-16450 # REMOTE SENSING INVESTIGATIONS FROM SPACECRAFT AND AIRCRAFT.

W. T. Pecora (U.S. Geological Survey, Washington, D.C.). *American Geophysical Union and Marine Technology Society, Symposium, Washington, D.C., Apr. 21-24, 1969, Paper. 13 p.*

Description of a cooperative research program in studying the earth by means of many types of remote sensing methods, including the use of aircraft and spacecraft. Some examples of the application of Gemini and Apollo photography to earth resource problems are described. It is noted that, to obtain a reliable assessment of hydrological potential and other resource inventories, it will be necessary to apply the capability of earth resource surveys from space to observe the same regions repetitively and under similar lighting conditions. Radar techniques hold great promise for imagery over cloud-covered areas. This use of radar in determining land use parameters and for solving related problems in both geological and geographical applications is also being evaluated. M.M.

A70-16683 INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, ANNUAL INTERNATIONAL GEOSCIENCE ELECTRONICS SYMPOSIUM, 1ST, WASHINGTON, D.C., APRIL 16-18, 1969, SELECTED PAPERS.

IEEE Transactions on Geoscience Electronics, vol. GE-7, Oct. 1969, 103 p.

CONTENTS:

INTRODUCTORY REMARKS. A. A. J. Hoffman, p. 178.

REMOTE SENSING.

COMMENTS ON REMOTE SENSING. R. Giacconi and B. Harris (American Science and Engineering, Inc., Cambridge, Mass.), p. 179-190, 19 refs.

MAPPING THE EARTH WITH ELASTIC WAVE HOLOGRAPHY. D. Silverman (Pan American Petroleum Corp., Tulsa, Okla.), p. 190-199, 26 refs.

THE DESIGN OF A RESOURCES SURVEY SYSTEM. M. Richter (TRW Systems Group, Redondo Beach, Calif.), p. 200-205. ENVIRONMENTAL POLLUTION.

CONTROL OF AIR POLLUTION THROUGH PROCESS OF LAW. M. H. Green (New Jersey State, Dept. of Health, Trenton, N.J.), p. 206-211.

CONTROL OF POLLUTION FROM THE GENERATION OF NUCLEAR POWER. W. de Laguna (Oak Ridge National Laboratory, Oak Ridge, Tenn.), p. 212-219.

AIR POLLUTION—THE RELATIONSHIP BETWEEN HEALTH EFFECT AND CONTROL PHILOSOPHY. E. J. Cassell (Mount Sinai School of Medicine, New York, N.Y.), p. 220-226.

OCEANOGRAPHIC INSTRUMENTATION.

A BUOY SUPPORTED ACOUSTICAL DATA ACQUISITION SYSTEM. H. Waugh, Jr. (Texas Instruments, Inc., Dallas, Tex.), p. 226-234.

TIME VARIATION OF THE ROUGH OCEAN SURFACE AND ITS EFFECT ON AN INCIDENT LASER BEAM. C. E. Prettyman (Ohio State University, Columbus, Ohio) and M. D. Cermak (University Hospitals, Cleveland, Ohio), p. 235-243.

METEOROLOGIC INSTRUMENTATION.

MEASUREMENTS OF WIND SPEEDS WITH AN OPTICAL CROSSBEAM SYSTEM. V. A. Sandborn (Colorado State University, Fort Collins, Colo.) and D. J. Pickelner (NASA, Marshall Space Flight Center, Huntsville, Ala.), p. 244-249.

FOG DROPLETS IN ELECTROSTATIC FIELD. P. C. Luan and J. B. Jordan (Université Laval, Quebec, Canada), p. 250-252, 9 refs.

SATELLITES AS INSTRUMENTS AND PLATFORMS.

A MINIATURE TWO-AXIS FLUXGATE MAGNETOMETER. M. H. Acuna and C. J. Pellerin (NASA, Goddard Space Flight Center, Greenbelt, Md.), p. 252-260, 10 refs.

GEODETIC AND GEOPHYSICAL APPLICATIONS OF LASER SATELLITE RANGING. C. G. Lehr (Smithsonian Astrophysical Observatory, Cambridge, Mass.), p. 261-267, 10 refs.

ABSOLUTE AND DIFFERENTIAL TEMPERATURE MONITORS DEVELOPED FOR APOLLO SPACE EXPERIMENTS. E. E. Swartzlander, Jr. (Hughes Aircraft Co., Culver City, Calif.), p. 267-273, 5 refs.

CONTRIBUTORS, p. 274-276.

1969 INDEX, 3 p.

A70-16769 # USE OF DEEP COOLING TO IMPROVE THE CHARACTERISTICS OF NUCLEAR-PRECESSION MAGNETOMETERS.

V. B. Kudriavtsev, A. P. Lysenko, V. I. Pochtarev, A. Ia. Rotshtein, and B. I. Rumiantsev (Akademiia Nauk SSSR, Institut Zemnogo Magnetizma, Ionosfery i Rasprostraneniia Radiovoln, Leningrad, USSR).

(*Geomagnetizm i Aeronomiia*, vol. 9, no. 2, 1969, p. 375-377.)

Geomagnetism and Aeronomy, vol. 9, no. 2, 1969, p. 304-306. Translation.

Analysis showing that by applying deep-freezing to the elements of a nuclear-precession magnetometer it is possible to greatly improve the instrument characteristics. The principal advantages are (1) a better measurement accuracy, (2) a wider range of measurements with respect to weak fields (including the magnetic fields in space), (3) an increased rate of measurement, and (4) the possibility of reducing the instrument dimensions. V.P.

A70-17152

SURVEYING THE EARTH FROM 20,000 MILES.

Alden P. Colvocoresses (U.S. Geological Survey, Washington, D.C.). *Society of Photographic Scientists and Engineers, Annual Convention, Los Angeles, Calif., May 12-16, 1969, Paper. 14 p. 6 refs.*

Application of the geostationary mode to earth sensing. The resolution requirements for an earth-scanning tracking telescope in orbit are examined. It is pointed out that at least three satellites would be needed to cover the principal land masses of the earth. The basic geometry of geostationary orbits is considered and the optical design of a practical instrument is discussed. G.R.

A70-17153

BALLOON FLIGHTS TO TEST REMOTE SENSORS.

Alden P. Colvocoresses (U.S. Geological Survey, Washington, D.C.). *American Society of Photogrammetry, Symposium on Earth Observations from Balloons, Washington, D.C., Feb. 6, 7, 1969, Paper. 9 p.*

Discussion of the use of balloons for testing remote-sensor systems taking into consideration advantages provided by the capability of balloons to hover and to reach very high altitudes. Major areas for the employment of balloons are outlined. A return-beam vidicon experiment and a tracking-telescope experiment involving the use of balloons are described. G.R.

A70-17343 *

COLLECTION OF DATA FROM IN SITU SENSORS VIA SATELLITE.

S. D. Dorfman (Hughes Aircraft Co., Space Systems Div., El Segundo, Calif.).

IN: COMMUNICATIONS AND DISPLAYS; WESTERN ELECTRONIC SHOW AND CONVENTION, SAN FRANCISCO, CALIF., AUGUST 19-22, 1969, TECHNICAL PAPERS. VOLUME 13. PART 2.

Convention sponsored by the Institute of Electrical and Electronics Engineers and the Western Electronic Manufacturers Association. North Hollywood, Calif., Western Periodicals Co., 1969, p. 12/1 1-12/1 13.

08 INSTRUMENTATION AND SENSORS

Contract No. NSR-09-012-909.

Description of some of the system considerations associated with collecting data from numerous in situ sensors. The type of sensors collecting earth-resources and meteorological data are identified. An assessment of approximate traffic for the 1975 time period is delineated. The rationale for collecting data via satellite rather than other, conventional means, is determined. General considerations regarding satellite orbits, coverage, collection rates, and configuration are presented, with specific reference to the problems of mobile platform location and multiplexing. A representative system configuration is presented as a basis for understanding the scope of the problem. Suggestions for systems and technology investigations are made. (Author)

A70-17415

AIRCRAFT MEASUREMENTS OF THE GROUND SURFACE TEMPERATURE AT HOHENPEISSENBERG AND ITS SURROUNDINGS (FLUGZEUGMESSUNGEN DER BODENBEREICH-TEMPERATUR AM HOHENPEISSENBERG UND IN SEINER UMGEBUNG).

Dieter Lorenz (Hohenpeissenberg, Meteorologisches Observatorium, Hohenpeissenberg, West Germany).

Archiv für Meteorologie, Geophysik und Bioklimatologie, Serie B—Klimatologie, Bioklimatologie, Strahlungsforschung, vol. 17, no. 4, 1969, p. 369-390. 8 refs. In German.

Research supported by the Deutsches Bundesministerium der Verteidigung.

Application of an airborne infrared pyrhelometer (wavelengths between 8 and 14 microns) to the measurement of the noontime ground temperature at the northern and southern slopes of a mountain in upper Bavaria. By reducing the measured data to a standard level, it proved possible to determine the relationship between the surface temperature and the exposure and slope angle for meadows and wooded areas. The surface temperature of the meadows is also calculated on the basis of the heat balance equation. V.P.

A70-18083 *

ATMOSPHERIC ENVIRONMENT—PROBLEMS OF REMOTE SENSING OF THE EARTH'S SURFACE.

Morris Tepper (NASA, Washington, D.C.).

American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 8th, New York, N.Y., Jan. 19-21, 1970, Paper 70-193. 10 p. 10 refs.

Members, \$1.00; nonmembers, \$1.50.

Remote sensing involves the measurement and interpretation of an electromagnetic signal received at a sensor located at a distance from the source. This interpretation involves considerations of the linear and angular motion of the platform carrying the sensor, the separation distance, instrument characteristics, system electronics and the effect of the intervening atmosphere. The important atmospheric processes which affect the incoming signal include absorption, scattering and emission and are discussed as a function of wavelength. (Author)

A70-18590

INSTRUMENT SOCIETY OF AMERICA, ANNUAL CONFERENCE, 24TH, HOUSTON, TEX., OCTOBER 27-30, 1969, PROCEEDINGS.

Pittsburgh, Instrument Society of America (Advances in Instrumentation. Volume 24. Part 3), 1969. 238 p.

Price of four parts, members, \$38.; nonmembers, \$58.

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DEVELOPMENTS IN LASER ALIGNMENT TECHNIQUES. G.

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A70-18594

OPTIMIZATION OF RADAR SCATTEROMETER SYSTEM.

Albert W. Biggs (Kansas, University, Lawrence, Kan.).

IN: INSTRUMENT SOCIETY OF AMERICA, ANNUAL CONFERENCE, 24TH, HOUSTON, TEX., OCTOBER 27-30, 1969, PROCEEDINGS.

Pittsburgh, Instrument Society of America (Advances in Instrumentation. Volume 24. Part 3), 1969, p. 637 1-637 7. 12 refs.

Contract No. N-62306-67-C-0044.

A brief review of CW, pulsed, and frequency modulated radar scatterometry systems is presented. Included in the presentation are flight, system, terrain, and data processing parameters. Flight parameters are the altitude, velocity, pitch, roll, and yaw of the aircraft. System parameters are the signal frequency, transmission mode (CW, pulse, or FM), antenna pattern, and, in the pulse of FM mode, pulse shape and width, repetition rate, and modulation index. Optimum resolution cell size and independent sample number are described in the above parameters. The terrain parameters are surface roughness variations which influence the dynamic range requirements. Data processing depends on the above factors. Results of sea state scatterometry measurements are presented in terms of some of these system parameters. (Author)

A70-19231

A HIGH-RESOLUTION IMAGE SENSOR.

Frank H. Eastman, III (RCA, Astro-Electronics Div., Princeton, N.J.).

(Society of Motion Picture and Television Engineers, Technical Conference, Washington, D.C., Nov. 10-15, 1968.)

SMPTe, Journal, vol. 79, Jan. 1970, p. 10-15.

Research sponsored by the Radio Corporation of America.

Description of the operation of the 2-in Return Beam Vidicon (RBV), and highlight of those parameters which make it particularly compatible with the requirements of the proposed Earth Resources Observation Satellite (EROS). The RBV camera system features a recently developed sensor which is capable of producing images with a resolution of 4500 TV lines. The RBV combines the advantages of the conventional storage vidicon ASOS photoconductor and the orthicon electron multiplier. The sensor operates in a slow-scan mode and utilizes the modulated return beam as a signal path to decrease the signal noise. The primary assets of this device are an improved low-light sensitivity, with higher SNRs than can be obtained with a conventional vidicon, coupled with extremely high resolution. The 4500-line video signal generated in the 1-in format is converted into a high-quality hard copy print by the Laser Beam Image Reproducer (LBIR). M.M.

A70-19618

A SELF-CALIBRATING RADIOMETER FOR IN-FLIGHT MEASUREMENT OF THERMAL MICROWAVE RADIATION FROM THE EARTH'S SURFACE (EIN SELBSTEICHENDES RADIOMETER ZUR MESSUNG DER THERMISCHEN MIKROWELLENSTRAHLUNG DES ERDBODENS VOM FLUGZEUG AUS).

Johann-Peter Hach.

München, Technische Hochschule, Fakultät für Maschinenwesen und Elektrotechnik, Dr.-Ing. Dissertation, 1968. 19 p. 5 refs. In German. Bundesministerium der Verteidigung Contract No. T-637-1-203.

A radiometer for in-flight measurement of microwave radiation is described, which employs two fixed reference temperatures above the ambient temperature in conjunction with a new type of signal processing. The readings obtained with this device are independent of the parameters of the microwave component. They refer directly to

the fixed difference between the two reference temperatures and are thus self-calibrated, thereby ensuring absolutely stable operation of the radiometer. A.B.K.

A70-19633 # **CALCULATION OF THE ILLUMINATION LEVELS OF AERIAL SURVEYS WITH COLOR PHOTOGRAPHIC MATERIALS (O RASCHETE OSVESHCHENNOSTI PRI AEROFOTOS'EMKE NA TSVETOFOTOGRAFICHESKIKH MATERIALAKH).**

V. Ia. Mikhailov and A. N. Uspenskii. *Geodeziia i Kartografiia*, vol. 14, no. 11, 1969, p. 56-59. In Russian.

Discussion of the illumination levels of aerial color photographs made on various types of color film at different angles of vision with 4 different aerial cameras. The minimum altitudes of the sun corresponding to the required times of exposure on different landscapes are calculated. V.Z.

A70-20716 # **Studies of natural resources using man-made satellites of the earth (Issledovaniia prirodnnykh resursov pri pomoshchi iskusstvennykh sputnikov zemli).** B. V. Vinogradov and K. Ia. Kondrat'ev. *Akademiia Nauk SSSR, Vestnik*, vol. 39, Dec. 1969, p. 53-62. 11 refs. In Russian.

Discussion of the use of satellites for meteorological and geographical studies. The use of information from television and infrared pictures of the earth obtained by satellite-borne instruments is considered. The determination of the radiation received and emitted by the earth is discussed taking into account the significance of this information for meteorological predictions. The importance of satellite observations for studies of dynamic processes is pointed out. Geographic studies of the climatic zones of the earth by satellite are considered. G.R.

A70-21542 **70-mm quadricamera system.** Joseph J. Ulliman, Robert P. Latham, and Merle P. Meyer (Minnesota, University, St. Paul, Minn.). *Photogrammetric Engineering*, vol. 36, Jan. 1970, p. 49-54.

An aircraft mounting plate for a multiple assembly of 70-mm cameras was designed and fabricated by the University of Minnesota School of Forestry with the assistance of Mark Hurd Aerial Surveys, Inc. The basic idea and inspiration of the plate assembly was provided by the CRREL four-camera system. The assembly permits up to four simultaneous exposures which can be stereoscopically viewed and compared at the same time in the uncut film strips. Development, calibration and operation of the system is discussed.

(Author)

A70-22851 * # **Sources of electromagnetic radiation.** Richard R. Legault (Michigan, University, Ann Arbor, Mich.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-287*. 22 p. 8 refs. Members, \$1.00; nonmembers, \$1.50. Contract No. NAS 9-9784.

Discussion of the characteristics of the remotely sensed electromagnetic radiation which can be used to identify water, moist soil, and vegetation. Materials are sufficiently diverse in their optical properties so that a wide range of identification problems can be solved by remote sensing techniques. The predictions of theoretical models and laboratory instrumentation can be used to select the sensor configuration and pattern recognition technique to implement the material identification. Some elementary concepts concerning the optical properties of materials are introduced. F.R.L.

A70-22867 # **A multispectral point scan camera for Earth Resources Technology Satellite.** W. G. Woo and E. G. Donelan (Westinghouse Defense and Space Center, Baltimore, Md.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-319*. 8 p. Members, \$1.00; nonmembers, \$1.50.

Description of a Westinghouse-conceived camera system that can be used as the remote sensor for the Earth Resources Satellite. It is capable of forming images and maintaining registration in several spectral regions, and has 100-ft ground resolution in a 100-mi field of view from a sun-synchronous orbit. The data received are in a form that can be processed and interpreted automatically and in real time. The camera utilizes currently available hardware components and technology. It is intended to operate in earth orbit for a minimum life of one year. It has a sufficient SNR to detect many geological and agricultural features on the earth's surface. Soil water content can be inferred by utilizing the spectral discrimination provided by the ERTS imaging. Sufficient SNR is available in the spectral regions of chlorophyll absorption and peak reflectivities to allow automatic recognition of important agricultural crop types. Among the engineering problems are the design of the scanning mechanism, the optics design, the environmental control system, and the design for system weight reduction. F.R.L.

A70-22870 # **State-of-the-art projection for infrared earth resources radiometry.** D. Goetze (Honeywell, Inc., Systems and Research Center, St. Paul, Minn.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-317*. 6 p. Members, \$1.00; nonmembers, \$1.50.

Specifications for a spectrally upper-bound (15 micron) infrared radiometer applicable to earth resources missions are presented. Specifications are developed assuming both state-of-the-art and advanced components. The specification development proceeds via design nomographs. With advances in the state of the art, ground resolution in the far infrared may be reduced from a present 250 meters to 10 meters. The pacing specification for the infrared radiometer is the optical aperture diameter which must be increased from a present 20 cm to 100 cm. The orbital altitude must be reduced from 500 km to 200 km. Contiguous imagery requires the development of a 10,000 element detector array in which the 0.05 millimeter elements are aligned within a length of 50 cm. Chopping frequencies must be extended to 7 KHz. (Author)

A70-22871 # **Earth Resources Sensor Integration.** Carl L. Kober (Martin Marietta Corp., Denver, Colo.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-316*. 6 p. Members, \$1.00; nonmembers, \$1.50.

Given an earth resources sensor package, the integration into a satellite or aircraft is a straight forward technical problem, solvable today. However, cost of integration and cost of data processing as a function of sensor generated data are requiring better integration solutions than available today. The paper describes the flow of conventional—classical—integration tasks, culminating in cost effectiveness and cost/benefit ratios indicating the problem. Analysis of the problem points to necessity of reducing data generation by sensors toward restriction to contrast changes, significant spectral data only and avoidance of redundant data. Comparison of trends in sensor group mixes with ideal requirements toward image sensors and spectral sensors show that presently, 'hybrid,' i.e., partially imaging/spectral sensors seem dominant, aggravating the integration task. Requirements to improve spectral sensors are formulated toward simpler, more cost effective integrated earth resources sensor groups. (Author)

A70-22872 # **The role of synthetic aperture radar in earth resource monitoring.** Louis J. Cutrona (KMS Technology Center, San Diego, Calif.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-315*. 10 p. 6 refs. Members, \$1.00; nonmembers, \$1.50.

A synthetic aperture radar has a number of properties which make its use desirable for earth resource monitoring. Specifically, the use of such a radar in a satellite is considered. The synthetic aperture radar can provide a resolution independent of range and wavelength. In satellite-borne applications, the problem of ambiguity avoidance

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requires special attention to antenna patterns. This results in a minimum antenna area rule. The transmitted power required is reasonable due to the necessity of using large antenna area. The radar produces a measure of local radar reflectivity over the surface of the earth. The spatial patterns contain information regarding the topography of the earth and the nature of the surface. In many cases, the nature of the terrain and of the vegetation can be inferred. Much work remains and needs to be done to increase the interpretability of the radar maps. (Author)

A70-22873 # Imaging with optical mechanical scanners from earth orbiting spacecraft. D. S. Lowe (Bendix Corp., Ann Arbor, Mich.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-314.* 10 p. 14 refs. Members, \$1.00; nonmembers, \$1.50.

Telemetry of multiband, high resolution spaceborne imagery is a formidable one when one desires large area coverage with near real time readout. For many earth resource applications, it appears that lower spatial resolution is acceptable providing one can enhance scene contrast or recognize objects on the basis of spectral information. Optical mechanical scanners are being developed for many space applications, and their capabilities and limitations are reviewed. The performance trade-off equation will be discussed with consideration of multi-channel operation. Design concepts for multispectral scanners are presented and performance estimates for the early 1970 time frame are given. Distortions introduced by spacecraft motion are analyzed and achievable accuracies in spatial fidelity are discussed. (Author)

A70-22887 # Earth resource sensors on aircraft, on spacecraft . . . and on the ground? Donald T. Lauer and Don L. Olson (Lockheed Electronics Co., Houston, Tex.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-296.* 9 p. 11 refs. Members, \$1.00; nonmembers, \$1.50.

Discussion of the significance of ground truth information as an essential aspect of remote sensing for reasons of image and environment calibration. Basic considerations involved in obtaining information by remote sensing are examined. Specific ground truth instrumentation, procurement procedures, reduction techniques and methods of correlating ground data with airborne data are discussed. G.R.

A70-22888 # A survey of sensors for earth resources sensing. Glenn A. Cato (TRW Systems Group, Redondo Beach, Calif.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-295.* 10 p. 12 refs. Members, \$1.00; nonmembers, \$1.50.

Discussion of differences among types of sensors and the advantages of these differences for the resource scientist to obtain the information he seeks. The EM spectrum and the principal atmospheric effects are examined. The main factors in sensor selection are discussed. Various types of cameras and radiometers are considered. Polarimeters, scanners, spectrometers, radars and particle and field meters are examined. G.R.

A70-22889 # Comparison of basic modes for imaging the earth. Alden P. Colvocoresses (U.S. Geological Survey, McLean, Va.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-294.* 7 p. Members, \$1.00; nonmembers, \$1.50.

Discussion of the more obvious characteristics of each of four basic modes for imaging the earth. The airborne mode considered is concerned with imaging systems carried by aircraft, balloon or similar platform within the atmosphere. The NASA-designated flights of ERTS A and B exemplify the data-transmission space mode from moderate (300 to 900 km) altitude. Earth-sensing flights in the

film-return mode last only a few weeks and do not attempt to provide near-real-time information. The geosynchronous mode involves a satellite at a distance of 20,000 miles which continuously hovers over the same area of the earth. G.R.

A70-22892 * # Interaction of infrared energy with the earth's atmosphere. W. A. Hovis (NASA, Goddard Space Flight Center, Greenbelt, Md.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-289.* 7 p. Members, \$1.00; nonmembers, \$1.50.

Study of the interaction of infrared energy with the earth's atmosphere as a basis for the determination of optimum wavelength intervals for multi-spectral scanners for earth resources applications. It is pointed out that the atmosphere of earth interacts with infrared energy principally by selective absorption of energy by carbon dioxide, water vapor, and other gases. Other absorptions occur due to clouds and other particulate matter such as dust. Data are presented which indicate what atmospheric parameters must be known to correct for atmospheric effects on remote sensing. G.R.

A70-22893 # Interaction of optical energy with the atmosphere. Seibert Q. Duntley (California, University, La Jolla, Calif.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-288.* 8 p. 6 refs. Members, \$1.00; nonmembers, \$1.50.

Brief description of the principles which govern the atmospheric limitations on remote sensors which use visible light provided by the sun. They include photography, the television imagery which is now planned for the first Earth Resources Technology Satellite, and vision by aviators or by astronauts in orbit. The optical nature of the atmosphere is discussed, and relations needed by those who design or operate remote sensing devices are provided, together with illustrative data. M.M.

A70-23066 Meteorological applications of lidar. W. E. Evans and R. T. H. Collis (Stanford Research Institute, Menlo Park, Calif.). *SPIE Journal*, vol. 8, Jan. 1970, p. 38-45. 25 refs.

Conventional microwave radar is used extensively by meteorologists in locating and tracking precipitating storms, and to some extent, by cloud physicists in determining physical characteristics of dense cloud. The more recent availability of highly collimated, nearly monochromatic, short-pulse light beams from laser sources makes it possible to use the radar technique for remote detection and measurement of minute concentrations of very small particles, down to those having dimensions on the order of the wavelength of light. This paper discusses the capabilities and limitations of the lidar technique, describes a sampling of the variety of meteorological applications that have been investigated experimentally to date, and attempts some conjecture on the probable direction of future research and application. Subjects covered include measurements of upper-atmosphere molecular density, structure and screening effects of tenuous cirrus clouds, tracking of atmospheric pollutants, single-ended measurements of visibility, remote measurement of smoke-plume opacity, and investigation of turbulence phenomena. The extremely high data rates resulting from the excellent spatial and temporal resolution capabilities of the lidar give rise to interesting problems in data storage and display, not all of which have been solved satisfactorily. These instrumentation aspects will be emphasized. (Author)

A70-23377 # Orbiting satellites and new possibilities of investigation (I satelliti in orbita e le nuove possibilità di indagine). U. Bardelli. *Ingegneria*, Jan. 1970, p. 23-28. In Italian.

Discussion of the possibility of future scientific observation of the earth by means of instruments carried on orbiting platforms. The instruments would be built along the lines of California Institute of Technology's 62-in reflecting telescope installed at Mount Wilson.

The possibility of studying phenomena such as earthquakes, volcanic eruptions, and atmospheric phenomena for weather forecasting purposes is discussed, together with the possibility of using artificial satellites to study phenomena connected with the formation of cyclones and anticyclones, floods, and soil erosion. M.M.

A70-23504 * # NASA program of airborne optical observations. M. Bader and C. B. Wagoner (NASA, Ames Research Center, Airborne Science Office, Moffett Field, Calif.). *Applied Optics*, vol. 9, Feb. 1970, p. 265-270. 28 refs.

NASA's Ames Research Center currently operates a Convair 990 four-engine jet transport as a National Facility for airborne scientific research (astronomy, aurora, airglow, meteorology, earth resources). This aircraft can carry about twelve experiments to 12 km for several hours. A second aircraft, a twin-engine Lear Jet, has been used on a limited basis for airborne science and can carry one experiment to 15 km for 1 h. Mobility and altitude are the principal advantages over ground sites, while large payload and personnel carrying capabilities, combined with ease of operations and relatively low cost, are the main advantages compared to balloons, rockets, or satellites. Typical airborne instrumentation and scientific results are presented. (Author)

A70-23523 * # Anisotropic reflectance characteristics of natural earth surfaces. B. Brennan and W. R. Bandeen (NASA, Goddard Space Flight Center, Greenbelt, Md.). *Applied Optics*, vol. 9, Feb. 1970, p. 405-412. 15 refs.

Measurement of the patterns of reflection of solar radiation from cloud, water, and land surfaces with an aircraft-borne medium-resolution radiometer. Reflectances in the 0.2 to 4.0-micron and 0.55 to 0.85-micron portions of the electromagnetic spectrum were investigated. Results indicate that the reflectance characteristics of most of the surface types measured are anisotropic. The anisotropy is dependent on the type of surface and the angles of incidence and reflection. In general, the anisotropy increases with increasing solar zenith angle. Clouds and forests show similar reflectance patterns, with forward and backward scattering peaks. Ocean surfaces yield a pattern similar to those of the clouds and forests but with an additional peak which is associated with sun glitter. Reflectances measured in the 0.2 to 4.0-micron band are generally lower than those in the 0.55 to 0.85-micron band under cloudy conditions. Anisotropy and spectral bandwidth should be accounted for when computing the albedo of the earth from narrow field-of-view measurements from satellites; otherwise, large errors may be expected to occur. (Author)

A70-23755 Multi-purpose multiband photographic system. B. Chang and D. Broyles (North American Rockwell Corp., Space Div., Downey, Calif.). In: Photo-optical instrumentation applications and theory; Society of Photo-optical Instrumentation Engineers, Annual Technical Symposium and Exhiborama, 14th, San Francisco, Calif., August 11-14, 1969, Proceedings. Volume 2. Symposium co-sponsored by the U.S. Army and the U.S. Air Force. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1969, p. 67-76.

Description of a multipurpose, multiband photographic system designed, in the case of aerial remote sensing, to be used either for the standard high resolution, low altitude (around 2500 ft) aerial photography in order to collect ground truth and training sample data for earth resources target areas, or for collecting specific multispectral data applicable to the various disciplines of the Earth Resources Program. The modular type system design provides the feature of lens interchangeability; thus, it can be used for lunar surface or inner planet mapping as well as earth-orbital remote sensing with varying resolution requirements. Atmospheric effects and factors affecting resolution of photographic film were considered in system design. The current configuration consists of commercially available cameras modified to optimize their optical capabilities in conjunction with solid-state analog and digital circuitry to perform control functions. F.R.L.

A70-23760 Remote sensing of earth resources from an early manned space station. Sol Zwirn (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.). In: Photo-optical instrumentation applications and theory; Society of Photo-optical Instrumentation Engineers, Annual Technical Symposium and Exhiborama, 14th, San Francisco, Calif., August 11-14, 1969, Proceedings. Volume 2. Symposium co-sponsored by the U.S. Army and the U.S. Air Force. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1969, p. 175-187. 13 refs.

Consideration of the Earth Resources program developed in a study by McDonnell Douglas Astronautics Co., and considered feasible for an Earth Orbital Space Station. The Earth Resources program objectives involve agriculture and forestry, geography and cartography, geology and hydrology, and oceanography and marine technology. The population explosion throughout the world, the industrial evolution of mankind, and the ensuing demand for natural resources make it imperative that maximum utilization of natural resources be made available to civilization. Experimental techniques described include visual and multispectral photography, IR imagery and spectroscopy, rf reflectivity, passive microwave radiometry and imagery, and absorption spectroscopy (remote sensing). F.R.L.

A70-23761 The aerial remote sensing package. B. Chang (North American Rockwell Corp., Space Div., Downey, Calif.). In: Photo-optical instrumentation applications and theory; Society of Photo-optical Instrumentation Engineers, Annual Technical Symposium and Exhiborama, 14th, San Francisco, Calif., August 11-14, 1969, Proceedings. Volume 2. Symposium co-sponsored by the U.S. Army and the U.S. Air Force. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1969, p. 189-198.

Discussion of remote sensing as applied to the Earth Resources Program. The sensor operating characteristics, the nature of the observable phenomena of target signatures, the operational environmental limitations, and the related data management equipment must be evaluated and perfected by means of the aerial remote sensing technology. In addition, the aerial remote sensing system can be utilized to fill the data collection gaps caused by (1) satellite orbital precession period, (2) obscuration due to high altitude cloud cover, and (3) an interrogative element for establishing local or regional high resolution ground truth. Some preliminary experimental results are presented. F.R.L.

A70-23763 * Microwave radiometric instrumentation for remote sensing applications. Herbert G. Pascalar (Aerojet-General Corp., El Monte, Calif.). In: Photo-optical instrumentation applications and theory; Society of Photo-optical Instrumentation Engineers, Annual Technical Symposium and Exhiborama, 14th, San Francisco, Calif., August 11-14, 1969, Proceedings. Volume 2. Symposium co-sponsored by the U.S. Army and the U.S. Air Force. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1969, p. 217-234. 11 refs. Contracts No. NAS 5-9680; No. NAS 9-7159; No. NAS 9-9627.

Study of radiometric imaging of terrestrial surfaces by sensing the thermal radiation at centimeter wavelengths (0.3 to 30 cm). At these wavelengths, which are very long compared to optical wavelengths, the radiation is relatively immune to scattering attenuation by fog and clouds. An additional significant feature is that at these wavelengths radiation from terrestrial surfaces provides distinctive signatures not observable in the infrared and visual spectrum. The physical principles, instrumentation techniques, and some of the remote sensing applications are described, as well as examples of recent results. F.R.L.

A70-24638 # The Tiros M satellite in an ERTS role. C. R. Hume (RCA, Astro-Electronics Div., Princeton, N.J.). (*British Interplanetary Society and NATO, International Summer School on Earth Resources Survey Satellites, Gonville and Caius College, Cambridge, England, July 14-25, 1969.*) *British Interplanetary Society, Journal*, vol. 23, Apr. 1970, p. 285-289.

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Discussion of the requirements of a spacecraft which can accommodate different earth resources sensor systems, considering as an example the Tiros M satellite. Special attention is given to the spacecraft structure, the satellite dynamics subsystem, the power subsystem, and the command and communications subsystem. Z.W.

A70-24743 Airborne use of the AGA Thermovision real time infrared scanner. Clifton Warren (Michigan, University, Ann Arbor, Mich.). In: American Society of Photogrammetry, Annual Meeting, 36th, Washington, D.C., March 1-6, 1970, Technical Papers. Falls Church, Va., American Society of Photogrammetry, 1970, p. 471-483. Research supported by the U.S. Department of the Interior and the Department of Land and Natural Resources of Hawaii.

Description of airborne applications of AGA Thermovision, a Swedish real-time infrared imaging system having the fastest scanning rate currently available for nonmilitary uses. The imaging system is not simply a thermal mapper but is a problem oriented instrument which can be used in well defined thermally oriented problems. It has the ability to vary the image in the air and to observe the results clearly and immediately; in addition, images can be recorded at will and in numerous ways. Applications were successfully tested in locating cold fresh water springs and in defining irrigation patterns. T.M.

A70-25045 SLR reconnaissance of Panama. Andris Viksne (U.S. Bureau of Mines, Washington, D.C.), Thomas C. Liston (Control Data Corp., Minneapolis, Minn.), and Cecil D. Sapp (Raytheon Co., Lexington, Mass.). (*Geophysics*, vol. 34, Feb. 1969, p. 55-64.) *Photogrammetric Engineering*, vol. 36, Mar. 1970, p. 253-259. Grants No. DA-AK-02-67-C-0167; No. DA-AK-02-67-C-0316.

SLR (Side-Looking Radar) was successfully used in lieu of optical photography for reconnaissance of the Darien Province of Panama and parts of Northwest Colombia, and for the construction of geoscience/APQ-97 side-looking radar was used to produce high-resolution imagery of an area containing approximately 6,600 square miles in 4 hours of flying time—an area, furthermore, that is almost perpetually cloud covered. The SLR imagery was used to prepare an uncontrolled mosaic and a series of geoscience overlays, including: Surface Drainage, Surface Configuration, Vegetation, Engineering Geology. The results of this study are believed to be unique in that they provide the first complete overview of Darien Province, thereby demonstrating the capability of SLR to gather geoscience data in an area that is notorious for the difficulties that its persistent cloud cover poses for the acquisition of usable conventional optical aerial photography. (Author)

A70-25627 # Long path atmospheric ozone absorption in the 9-10-micron region observed from a balloon-borne spectrometer. A. Goldman, T. G. Kyle, D. G. Murcray, F. H. Murcray, and W. J. Williams (Denver, University, Denver, Colo.). *Applied Optics*, vol. 9, Mar. 1970, p. 565-580. 18 refs. ARPA-supported research.

Measurement of the atmospheric absorption of solar radiation in the 9 to 10-micron region as a function of altitude, using a balloon-borne spectrometer. Among the numerous spectra recorded, several were made with very long optimal paths above the troposphere obtained from floating altitude while the sun set. When the experimental results are compared with calculated spectra, combined with the Curtis-Godson approximation, large discrepancies are found for the long path spectra. M.M.

A70-25642 # A comparison of microdensitometry and TV waveform analysis as expressions of observed landscape patterns on radar. N. R. Nunnally (Illinois, University, Urbana, Ill.). *Applied Optics*, vol. 9, Mar. 1970, p. 749-751. 5 refs. Contracts No. Nonr-4761(00); No. N 0014-66-C-0050-A01.

Delimiting landscape regions with radar is largely dependent upon recognition of variations in texture patterns on the radar image.

Since texture is a function of frequency and magnitude of tone or density changes over discrete distances any objective means of evaluating textures must be based on mechanically measuring and recording tonal information. Comparison of microdensitometer traces with television waveforms reveals that, for similar resolution systems, essentially the same textural information can be obtained from either system. Many interpreters who do not have access to scanning densitometers do have access to television equipment. This, and the fact that the location of the scan line being analyzed can be viewed simultaneously on the television monitor, favors waveform analysis for many interpretation situations. (Author)

A70-26902 # Passive microwave sensors for satellites. J. W. Sherman, III (U.S. Naval Oceanographic Office, Washington, D.C.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 2. Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 651-669. 21 refs.

Discussion of the observation of ocean surface properties by passive microwave sensors. It is pointed out that while signatures to separate surface roughness features from thermal properties of the sea surface have not been determined uniquely, sufficient correlation does exist to permit microwave radiometers to be oceanographic sensor candidates for space platforms. Studies of the existing capability to collect synoptic thermal data imply that a four to fivefold increase in the data base is needed to permit prediction of sea surface temperature to within plus or minus 1 deg C absolute. Microwave radiometers are conceptually capable of meeting this goal with surface resolutions on the order of thirty to forty nautical miles. In order for such a space system to be useful, the conventional image of the surface must be discarded, and in its place the satellite sensed thermal data processed through prediction systems which contain the logic for ocean thermal properties. A preliminary analysis illustrates the need for a joint effort between oceanographers and space microwave radiometer designers to bring a passive system to fruition for measuring and forecasting sea surface temperature. M.M.

A70-26929 International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 1. Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969 663 p. Price of two volumes, \$15.

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A spectral discrimination technique for agricultural applications. D. L. Earing (Michigan, University, Ann Arbor, Mich.) and I. W. Ginsberg (Sensors, Inc., Ann Arbor, Mich.), p. 21-32. 6 refs.

Multispectral imagery and automatic classification of spectral response for detailed engineering soils mapping. M. G. Tanguay (Ecole Polytechnique, Montreal, Canada), R. M. Hoffer, and R. D. Miles (Purdue University, Lafayette, Ind.), p. 33-63. 10 refs.

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S. Thomson (Michigan, University, Ann Arbor, Mich.), p. 65-75, 77. 9 refs.

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Some results of inflight testing an infrared sensor as a clear air turbulence detector. II. R. Jimenez (Pan American World Airways, Inc., Jamaica, N.Y.), p. 308-326. 8 refs.

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Use of millimeter wave radiometry to remotely measure atmospheric stability. W. D. Mount (Sperry Rand Research Center, Sudbury, Mass.), p. 469-491.

Geological applications of remote sensing.

Geological comparison of spacecraft and aircraft photographs of the Potrillo Mountains, New Mexico, and Franklin Mountains, Texas. D. L. Amsbury (NASA, Manned Spacecraft Center, Houston, Tex.), p. 493-515. 25 refs.

Aerial infrared surveys and borehole temperature measurements of coal mine fires in Pennsylvania. G. W. Greene (U.S. Geological Survey, Denver, Colo.), R. M. Moxham (U.S. Geological Survey, Washington, D.C.), and A. H. Harvey (U.S. Bureau of Mines, Washington, D.C.), p. 517-525.

Airborne geological mapping using infrared emission spectra. I. R. J. P. Lyon (Stanford University, Stanford, Calif.) and J. Patterson (E.R.A., Inc., Houston, Tex.), p. 527-552. 7 refs.

Comparison of airborne spectral gamma radiation data with field verification measurements. A. E. Purvis and F. J. Buckmeier (Texas Instruments, Inc., Dallas, Tex.), p. 553-564.

Remote sensing of luminescent materials. W. R. Hemphill, G. E. Stoertz (U.S. Geological Survey, Washington, D.C.), and D. A. Markle (Perkin-Elmer Corp., Norwalk, Conn.), p. 565-585. 30 refs.

An experimental evaluation of the basic assumptions used in the analysis of microwave radiometric ground truth data. R. J. Hruby, B. Ragert (NASA, Ames Research Center, Moffett Field, Calif.), and A. T. Edgerton (Aerojet-General Corp., El Monte, Calif.), p. 587-602. 5 refs.

Pseudo-radar topographic shadowing for detection of sub-continental sized fracture systems. D. U. Wise (Massachusetts, University, Amherst, Mass.; Franklin and Marshall College, Lancaster, Pa.), p. 603-615. 6 refs.

Recent developments in remote sensing for geophysical applications. A. R. Barringer and J. D. McNeill (Barringer Research, Ltd., Rexdale, Ontario, Canada), p. 617-636.

The influence of radar look-direction on the detection of selected geological features. H. C. MacDonald, J. N. Kirk, L. F. Dellwig, and A. J. Lewis (Kansas, University, Lawrence, Kan.), p. 637-650. 15 refs.

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A70-26935 # Preprocessing transformations and their effects on multispectral recognition. F. J. Kriegler, W. A. Malila, R. F. Nalepka, and W. Richardson (Michigan, University, Ann Arbor, Mich.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 1.

Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 97-131. U.S. Department of Agriculture Contract No. USDA-12-14-100-9548(20).

Preliminary results of a study of an intermediate data transformation step, called preprocessing, which is applied between the collection of multispectral data by a multichannel optical-mechanical scanner and the automatic pattern recognition operations. The objective of preprocessing is to transform the sensor outputs (in the

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observation space) into a feature space in which new signatures, less dependent on the environmental, observational, and sensor conditions, can be extracted. Examples are presented of recognition processing of an agricultural area both with and without preprocessing operations. One example demonstrates the capability, with the use of preprocessing, to recognize both sunlit and shadowed portions of a field while only employing a single signature to describe the two portions. Another example demonstrates the capability of preprocessing to extend a signature derived from a small interval of scan angle to a much wider interval over which there is a substantial variation in signal amplitude. T.M.

A70-26936 # The inventory of earth resources on enhanced multiband space photography. Robert N. Colwell and Jerry D. Lent (California, University, Berkeley, Calif.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 1. Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 133-143. 8 refs.

Discussion of the nature, capabilities, and limitations of a number of specialized remote sensing techniques, including those designed to help image analysts extract useful information from enhanced multiband images. Special emphasis is given to the usefulness of such techniques for the inventory of agricultural crops and certain other kinds of earth resources. The purpose of image enhancement, i.e., the basic principle of all these techniques, is twofold: (1) to increase the total amount of information derivable from the 'raw data,' and (2) to facilitate the data extraction process. Both optical and electronic means of image enhancement are discussed. Although these techniques show great promise for use in the making of earth resource surveys, they are still in the developmental stage. Areas in need of additional research are specified. M.V.E.

A70-26938 # Capability of airborne laser profilometer to measure terrain roughness. L. E. Link (U.S. Army, Waterways Experiment Station, Vicksburg, Miss.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 1. Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 189-196.

Measurements were made at 12 test sites to determine the feasibility of rapidly assessing ground roughness with an airborne laser profilometer system. Test sites were selected that exhibited variations in terrain surface roughness, vegetation cover, and natural obstacles that might have an effect on military activities. The capabilities of the laser system were assessed on the basis of its ability to perceive and record these terrain features. The results of this study indicate that a laser profilometer system may be a useful tool for adjudging terrain roughness if the sources of error are eliminated. (Author)

A70-26940 * # Accuracy of determining sensor boresight position during aircraft flight-test. W. G. Eppler (Lockheed Electronics Co., Houston, Tex.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 1. Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 205-226. 10 refs. Contract No. NAS 9-5191.

A method for displaying non-imaging remote sensor data in spatial registration with the ground scene has been developed. Transparent overlays showing the sensor boresight path and output signals with respect to aerial photographs can be prepared rapidly and economically by computer. Flight-test experiments have been

conducted to determine quantitatively the spatial accuracy of the computer-generated overlays. These tests showed that the RMS errors between the computed and the actual boresight positions is approximately 1/4 deg referred to the sensor. Because these errors are comparable to or smaller than the beamwidth of most non-imaging sensors, it appears that the overlays are sufficiently accurate to aid in the correlation and analysis of remote sensor data. (Author)

A70-26941 * # Optimization of a multispectral scanner for ERTS. Virginia T. Norwood (Hughes Aircraft Co., Culver City, Calif.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 1. Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 227-235. Contract No. NAS 5-11624.

A very broadband scanner capable of imaging from Earth Resources Technology Satellite (ERTS) orbits with resolution between 100 and 200 feet has been designed. The single optical system will accommodate a number of spectral bands in the range from ultraviolet to far infrared to provide the excellent registration needed for 'signature' analysis of agricultural scenes. The equations relating scanner and orbital parameters to performance are given along with the reasons for selecting the actual design values. (Author)

A70-26958 # Remote sensing of luminescent materials. William R. Hemphill, George E. Stoertz (U.S. Geological Survey, Washington, D.C.), and David A. Markle (Perkin-Elmer Corp., Norwalk, Conn.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 1. Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 565-585. 30 refs.

Discussion of the Fraunhofer line-depth method, which uses the sun as an excitation source, as a means of detecting luminescent materials during daylight. The method involves comparing a selected Fraunhofer line in the solar spectrum with the same line in a spectrum reflected from a material suspected to luminesce; luminescence is indicated where the ratio of the central intensity of the line to the adjacent continuum in the reflected spectrum exceeds its solar conjugate. A prototype Fraunhofer line discriminator, suitable for aircraft operation, is described. F.R.L.

A70-27566 # Possibility of averaging the rocking angles of a moving object during measurements of the geomagnetic field vector components (O vozmozhnosti osredneniia uglov kachaniia dvizhu-shchegosia ob'ekta pri izmereniiakh komponent vektora magnitnogo polia zemli). S. F. Farmakovskii and L. I. Popkova (Leningradskii Institut Tochnoi Mekhaniki i Optiki, Leningrad, USSR). *Priboro-stroenie*, vol. 13, no. 2, 1970, p. 91-96. In Russian.

Demonstration of the basic possibility of averaging the angles of rotation of a moving object over the period of a single measurement by a quantum magnetometer, during conversion of the craft's geomagnetic field vector components into the geographic counterparts. In the case of indirect stabilization of magnetometers on board a moving object, they measure the geomagnetic field vector components in a coordinate system tied to the object. Using signals from the navigational systems about the object's angles of rotation, these field vector components are converted by computer from the craft's coordinate system into a geographic system. Quantum magnetometers provide mean values of the corresponding components over the period of a single measurement, while the navigational systems give continuous information about the object's angles of rotation. The present study attempts to provide an answer to the question of which angle measurements correspond to the measured field components. T.M.

A70-27744

The research potential of manned earth orbiting spacecraft for meteorology. S. Fred Singer (U.S. Department of the Interior, Washington, D.C.). In: *Manned laboratories in space; International Academy of Astronautics, International Astronautical Congress, 19th, International Orbital Laboratory Symposium, 2nd, New York, N.Y., October 18, 1968, Proceedings.* Edited by S. F. Singer. Dordrecht, D. Reidel Publishing Co. (Astrophysics and Space Science Library. Volume 16), 1969, p. 33-45. 5 refs.

Review of the many important ways in which manned satellites can advance atmospheric science. They can rapidly and economically develop a refined system of electromagnetic sensing instrumentation which can be employed on future operational weather satellites. They can carry out specialized observing programs, e.g., in connection with earth-based storm modification experiments. They can perform a maintenance and repair function for the advanced weather satellites in a future operational system. A human experimenter can make unique contributions in devising instrumentation to measure nighttime cloud distribution, winds, temperatures, precipitation, water vapor and ozone content, cloud properties, aerosols, and the state of the sea, of snow, ice, and terrain. The economic value of an advanced weather satellite system in terms of improved weather forecasts is pointed out, and it may also help to solve scientific questions concerning climatic changes. F.R.L.

A70-27745

Terrain spectral imagery from space in various spectral regions. K. Ia. Kondrat'ev, V. D. Stepanenko, and B. V. Vinogradov (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR). In: *Manned laboratories in space; International Academy of Astronautics, International Astronautical Congress, 19th, International Orbital Laboratory Symposium, 2nd, New York, N.Y., October 18, 1968, Proceedings.* Edited by S. F. Singer. Dordrecht, D. Reidel Publishing Co. (Astrophysics and Space Science Library. Volume 16), 1969, p. 46-47. 83 refs.

Discussion of the possibilities and results of interpretations of earth observations from satellites for use in geosciences and other investigations of natural resources. Different regions of the electromagnetic spectrum can give different and often complementary information about the atmosphere, the surface (land, vegetation, ocean, ice, hydrology), and subsurface. Attention is given to space photography, both black-and-white as well as multispectral, with application to terrestrial natural resource problems; to infrared pictures of the earth in transparency windows and absorption bands, with possibilities of their meteorological interpretation; to space spectrophotometry, i.e., the identification of the spectra of surface formations with the purpose of discerning the mineralogical composition of rocks, and for geobotanical investigations; and to radar pictures of surface formations, their advantages, and the possibilities of active and passive microwave sensing. F.R.L.

A70-27901

EASCON '69; Institute of Electrical and Electronics Engineers, Electronics and Aerospace Systems Convention, Washington, D.C., October 27-29, 1969, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1969. 317 p. Members, \$15.; nonmembers, \$20.

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Analysis and measurement of the noise limited performance of an infrared imaging system. J. M. Lloyd (U.S. Army, Night Vision and Target Acquisition Laboratories, Fort Monmouth, N.J.) and R. L. Sendall (Electro-Optical Systems, Inc., Pasadena, Calif.), p. 312.

Man - The final stage of an electro-optical imaging system. R. R. Legault (Michigan, University, Ann Arbor, Mich.), p. 16-21. 14 refs.

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Quadri-phase-shift-keyed signal detection with noisy reference signal. R. J. Sherman (Philco-Ford Corp., Philadelphia, Pa.), p. 45-52.

A new threshold extension demodulator for FM multiplex. N. C. Hekimian (Hekimian Laboratories, Inc., Rockville, Md.) and W. Mack (Page Communication Engineers, Inc., Washington, D.C.), p. 53-61. 9 refs.

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Department of Transportation ATC committee report. B. Alexander (General Research Corp., Santa Barbara, Calif.), p. 312.

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Tactical communications satellite No. 1 repeater design and performance. R. D. Brandes, p. 312.

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A multiple user satellite system for navigation and traffic control. L. M. Keane (NASA, Electronics Research Center, Cambridge, Mass.), p. 190-197. 10 refs.

A satellite system to support an advanced air traffic control concept. J. B. Woodford (Aerospace Corp., El Segundo, Calif.), p. 198-202.

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Gibson (North American Rockwell Corp., Anaheim, Calif.), p. 251-256. 8 refs.

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Noise cleaning in digital pictures. A. Rosenfeld, C. M. Park (Maryland, University, College Park, Md.) and J. P. Strong (NASA, Goddard Space Flight Center, Greenbelt, Md.), p. 264-273. 8 refs.

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Multifunction radar waveforms. W. Fishbein and O. E. Rittenbach (U.S. Army, Electronics Command, Fort Monmouth, N.J.), p. 280-285. 5 refs.

Sea clutter measurements by a four-frequency radar. M. B. Laing (U.S. Navy, Naval Research Laboratory, Washington, D.C.), p. 286-293.

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Use of wideband stochastic signals for measuring range and velocity. C. D. McGillem, G. R. Cooper, and W. B. Waltman (Purdue University, Lafayette, Ind.), p. 305-311. 8 refs.

Machine plotting of radar/radio vertical-plane coverage diagrams. L. V. Blake (U.S. Navy, Naval Research Laboratory, Washington, D.C.), p. 315.

A70-28270 # Global photography of the earth (Global'noe fotografirovanie zemli). B. V. Vinogradov. *Zemlia i Vselennaya*, Jan.-Feb. 1970, p. 31-38. In Russian.

Survey of the current capabilities of satellites for large-scale photography of the entire globe. The difficulties associated with mosaic patterns of the entire earth surface are outlined, and the advantages offered by complete photographs from large distances are explained. Examples of photographs obtained from ATS and Molniya satellites are given, and the interpretation of evident features is demonstrated. T.M.

A70-29176 # A random Doppler measurement technique for the global atmospheric research program. John E. Masterson (National Center for Atmospheric Research, Boulder, Colo.). *American Meteorological Society, Bulletin*, vol. 51, Mar. 1970, p. 222-226. 20 refs.

A proposed satellite-based environmental measurement system could contribute some of the important basic variables to the Global Atmospheric Research Program (GARP) initial data set at low cost and within acceptable limits of accuracy. Randomly-timed signals from constant-level balloons, free-drifting buoys, and remote land stations would transmit in situ data to the satellite via low power modulated oscillators; Doppler shifts in the signal frequency would allow computation of the platform positions. No satellite interrogation of the environmental platforms would be necessary. The capabilities, function, and comparative advantages of the proposed system are enumerated. (Author)

A70-29651 Precision radiometry. Edited by A. J. Drummond (Eppley Laboratory, Inc., Newport, R.I.). New York, Academic Press, Inc. (Advanced in Geophysics. Volume 14), 1970. 424 p. \$19.50.

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- Blackbodies as absolute radiation standards. R. E. Bedford (National Research Council, Ottawa, Canada), p. 165-202. 82 refs.
- Experimental blackbody (absolute) radiometry. A. R. Karoli (Eppley Laboratory, Inc., Newport, R.I.), p. 203-226. 55 refs.
- Laboratory methods of experimental radiometry including data analysis. J. R. Hickey (Eppley Laboratory, Inc., Newport, R.I.), p. 227-267. 18 refs.
- On determinations of the atmospheric turbidity and their relation to pyrheliometric measurements. A. K. Ångström, p. 269-284. 29 refs.
- Some meteorological aspects of radiation and radiation measurement. G. D. Robinson (Travelers Research Center, Inc., Hartford, Conn.), p. 285-306. 28 refs.
- Measurement of radiation flux and equivalent radiation temperature in the atmosphere. J. Strong (Massachusetts, University, Amherst, Mass.), p. 307-329. 18 refs.
- Applications of thermal radiation measurements in atmospheric science. P. M. Kuhn (ESSA, Boulder, Colo.), p. 331-357. 19 refs.
- Recent advances in satellite radiation measurements. R. A. Hanel (NASA, Goddard Space Flight Center, Greenbelt, Md.), p. 359-390. 50 refs.
- The design and construction of evaporated multilayer filters for use in solar radiation technology. E. E. Barr, p. 391-415. 11 refs.
- Appendix - Radiation terminology, symbols, units, and conversion factors, p. 413-415.

A70-30614 * # Real-time meteorological support for Apollo 9 scientific photography. Ivan D. Browne, David E. Pitts, and Victor S. Whitehead (NASA, Manned Spacecraft Center, Houston, Tex.). In: National Conference on Aerospace Meteorology, 4th, Las Vegas, Nev., May 4-7, 1970, Preprints. Conference sponsored by the American Meteorological Society and the American Institute of Aeronautics and Astronautics. Boston, American Meteorological Society, 1970, p. **1-***9.

Discussion of the meteorological support aspect of the real-time planning for the Apollo 9 scientific photography mission. The main postmission observations and comments include the following: (1) during the Apollo 9 mission, it was not possible at all times to obtain target forecasts from the National Weather Satellite Center because of lack of time; more time should be provided between the choice of photographic targets and their acquisition; (2) many potential targets, including those of meteorological interest, could not be photographed because of crew sleep cycles; crew sleep cycles should be gradually changed or staggered so that all targets can be photo-

graphed; and (3) prior to flight, every effort should be made to brief future flightcrews on meteorological phenomena of timely interest. M.V.E.

A70-30825 # Dynamics of magnetically conjugate regions in the F2-layer of the ionosphere. N. P. Ben'kova, G. V. Bukin, L. E. Kolokolov, M. Lafaile, C. Taieb, and G. Faynot (Akademii Nauk SSSR, Institut Zemnogo Magnetizma, Ionosfery i Rasprostraneniia Radiovoln, Krasnaya Pakhra, USSR; CNET, Groupe de Recherches Ionosphériques, Issy-les-Moulineaux, Hauts-de-Seine, France). (*Geomagnetizm i Aeronomiia*, vol. 9, no. 5, 1969, p. 923-926.) *Geomagnetism and Aeronomy*, vol. 9, no. 5, 1969, p. 742-744. Translation.

Discussion of aircraft vertical ionospheric sounding observations carried out in September and October 1966 during a French-Soviet experiment at magnetically conjugate stations at Archangel and Sogra and at Kerguelen Island. The results confirm the existence of a positive correlation between normal ionizations at these conjugate locations and support previous conclusions concerning the mechanisms of negative and positive geomagnetic conjugation. V.Z.

A70-31231 Nomogram relating true and apparent radiometric temperatures of graybodies in the presence of an atmosphere. Emmanuel E. Bliamptis (USAF, Office of Aerospace Research, Bedford, Mass.). *Remote Sensing of Environment*, vol. 1, Mar. 1970, p. 93, 94. 5 refs.

A nomogram is given which is suitable for graphical calculation of the true temperature (emitted radiance) of a remote graybody if its apparent temperature (measured radiance) and emissivity are given along with the sky temperature (ambient radiance). Quick computation of other quantities is possible by graphical construction and linear interpolation. (Author)

A70-31325 Geomagnetic micropulsations. J. A. Jacobs (Alberta, University, Edmonton, Alberta, Canada). New York, Springer-Verlag (Physics and Chemistry in Space. Volume 1), 1970. 186p. 287 refs. \$9.90.

An attempt is made to summarize our current knowledge - both observational and theoretical - concerning short-period fluctuations of the earth's magnetic field (micropulsations) and their use as natural probes for remote sensing of the magnetosphere. The basic dynamic processes governing magnetically trapped particles are discussed, with particular reference to the earth's radiation belts. The book is primarily intended to help graduate students (and researchers new to the field) to understand the underlying physics and to provide them with guidelines for quantitative applications of the theory. Particular attention is given to adiabatic theory and its application to studies of radiation belts. A special chapter is devoted to particle diffusion. Mathematical treatment is kept as simple as possible, greater emphasis being placed on the physical picture and on practical numerical computation methods. The book should also be of interest to students of plasma physics and astrophysics. V.P.

A70-31777 # Synthesis of requirements for advanced earth resources sensors. A. Adelman and L. Williams (IBM Corp., Space Systems Center, Huntsville, Ala.). *International Astronautical Federation, Congress, 20th, Mar del Plata, Argentina, Oct. 5-10, 1969, Paper*. 52 p. 8 refs.

Outline of a user-oriented method of determining measurement requirements and the application of common-purpose requirements synthesis to determine the minimum sensor characteristics required to investigate earth resources. Current sensor development programs are considered to allow definition of the earliest possible sensor grouping available for earth applications missions. The earth-oriented sciences and service disciplines reviewed are communications and navigation/traffic control, atmospheric science and technology, geography, oceanography/marine technology, geology/hydrology, and agriculture/forestry. F.R.L.

A70-32063 Satellite meteorology (Sputnikovaia meteorologiya). Edited by V. G. Boldyrev and N. F. Vel'tishchev. Leningrad, Gidrometeoizdat (Gidrometeorologicheskii Nauchno-Issledovatel'skii Tsentr SSSR, Trudy, No. 50), 1969. 116 p. In Russian.

Contents:

Cellular convection in the atmosphere (lacheikovaia konveksiia v atmosfere). N. F. Vel'tishchev, p. 3-21. 7 refs.

Meteorological conditions for the formation of convective cloud banks (Meteorologicheskie usloviia obrazovaniia griad konvektivnoi oblachnosti). N. F. Vel'tishchev and A. A. Zhelnin, p. 22-30. 10 refs.

Applicability of satellite cloud data in objective wind field analysis (K voprosu ob ispol'zovanii sputnikovyykh dannykh ob oblachnosti v ob'ektivnom analize polia vetra). L. A. Anekeeva, p. 31-36.

Results of an investigation of the spatial-temporal variability of cloudiness above the European territory of the USSR (Rezultaty issledovaniia prostranstvenno-vremennoi izmenchivosti oblachnosti na evropeiskoi territorii SSSR). D. M. Sonechkin and I. S. Khandurova, p. 37-46.

Radiation and heat fluxes in the atmosphere from empirical and analytical data (Radiatsionnye potoki i pritoki teplo k atmosfere po empiricheskim i rasschitannym dannym). L. V. Berkovich, p. 47-53. 5 refs.

Atmospheric fronts and intertropical convergence zones on radiation temperature charts (Atmosfernye fronty i vnutritropicheskie zony konvergentsii na karkakh radiatsionnykh temperatur). P. N. Belov, Iu. V. Kurilova, and G. L. Slepenskova, p. 54-59.

Characteristics of cloud fields in the tropics from satellite radiation measurements (Osobennosti oblachnykh polei v tropikakh po radiatsionnym izmereniiam so sputnikov). I. N. Belov, Iu. V. Kurilova, and I. R. Egorova, p. 60-74.

Determination of sea surface temperature and atmospheric humidity from satellite measurements of the thermal radio emission of the earth atmosphere system (Opredeleniye temperatury morskoi poverkhnosti i vlagosoderzhanii atmosfery po izmereniiam teplovogo radioizlucheniia sistemy zemlia-atmosfera s ISZ). E. P. Dombkovskaia, p. 75-85. 16 refs.

Contrasts of the radio brightness temperatures of clouds and rain in the superhigh-frequency range (Kontrasty radioiarkostnykh temperatur oblakov i dozhdei v sverkhvysokochastotnom diapazone). B. G. Kutuz, L. M. Mitnik, and A. M. Shutko, p. 86-93. 12 refs.

Method of determining atmospheric humidity from satellite radiometric measurements of superhigh-frequency radiation (Metodika opredeleniia vlagosoderzhanii atmosfery po radiometricheskim izmereniiam sverkhvysokochastotnogo izlucheniia s ISZ). L. M. Mitnik, p. 94-102. 20 refs.

Determination of the temperature and some physical characteristics of the earth's surface from satellite radiometric measurements of superhigh-frequency radiation (K voprosu opredeleniia temperatury i nekotorykh fizicheskikh kharakteristik poverkhnosti zemli po radiometricheskim izmereniiam sverkhvysokochastotnogo izlucheniia s ISZ). A. M. Shutko, p. 103-110. 18 refs.

A70-32070 # Contrasts of the radio brightness temperatures of clouds and rain in the superhigh-frequency range (Kontrasty radioiarkostnykh temperatur oblakov i dozhdei v sverkhvysokochastotnom diapazone). B. G. Kutuz, L. M. Mitnik, and A. M. Shutko. In: Satellite meteorology (Sputnikovaia meteorologiya). Edited by V. G. Boldyrev and N. F. Vel'tishchev. Leningrad, Gidrometeoizdat (Gidrometeorologicheskii Nauchno-Issledovatel'skii Tsentr SSSR, Trudy, No. 50), 1969, p. 86-93. 12 refs. In Russian.

Evaluation of the contrasts of the radio brightness temperatures of clouds and precipitations above several typical type of the earth's surface, with allowance for the humidity (due to precipitations) of the underlying surface, for such meteorological conditions as clear-sky atmospheres, cloudy atmospheres, and atmospheres in the

presence of clouds and precipitations. Use is made of radio brightness temperatures measured on board meteorological satellites. The radio emission of the system composed of the earth and the atmosphere is calculated for wavelengths of 0.8 and 3 cm and vertical and horizontal polarization. It is shown that the value of radio brightness contrasts depends strongly on the humidity of the underlying surface. V.P.

A70-32071 # Method of determining atmospheric humidity from satellite radiometric measurements of superhigh-frequency radiation (Metodika opredeleniia vlagosoderzhanii atmosfery po radiometricheskim izmereniiam sverkhvysokochastotnogo izlucheniia s ISZ). L. M. Mitnik. In: Satellite meteorology (Sputnikovaia meteorologiya). Edited by V. G. Boldyrev and N. F. Vel'tishchev. Leningrad, Gidrometeoizdat (Gidrometeorologicheskii Nauchno-Issledovatel'skii Tsentr SSSR, Trudy, No. 50), 1969, p. 94-102. 20 refs. In Russian.

Development of a method of determining atmospheric humidity on the basis of simultaneous measurements of the radio emission of the system composed of the earth and its atmosphere at wavelengths ranging between 0.8 and 10 cm. The possibility of determining atmospheric humidity even in the presence of clouds is demonstrated. The influence of systematic and random errors on the accuracy of measurements of atmospheric humidity and total water content of clouds is analyzed for measurements performed above the sea surface. V.P.

A70-32072 # Determination of the temperature and some physical characteristics of the earth's surface from satellite radiometric measurements of superhigh-frequency radiation (K voprosu opredeleniia temperatury i nekotorykh fizicheskikh kharakteristik poverkhnosti zemli po radiometricheskim izmereniiam sverkhvysokochastotnogo izlucheniia s ISZ). A. M. Shutko. In: Satellite meteorology (Sputnikovaia meteorologiya). Edited by V. G. Boldyrev and N. F. Vel'tishchev. Leningrad, Gidrometeoizdat (Gidrometeorologicheskii Nauchno-Issledovatel'skii Tsentr SSSR, Trudy, No. 50), 1969, p. 103-110. 18 refs. In Russian.

Discussion of some methodological questions associated with the determination of the temperature, emissivity, and dielectric constant of various forms of the earth's surface from satellite radiometric measurements at wavelengths between 0.5 and 1.0 cm (above land) and 3 to 5 cm (above water). It is shown that such measurements make it possible to determine the vertical temperature profile at depths of several meters below the earth's surface. V.P.

A70-32977 Radar and dc pulse signatures. C. W. Harrison, Jr. and R. E. Jones (Sandia Laboratories, Albuquerque, N. Mex.). *IEEE Transactions on Antennas and Propagation*, vol. AP-18, May 1970, p. 430, 431.

Radar and dc pulses of Gaussian shape are reflected from dry, damp, and wet earth for both vertical and horizontal polarization. The envelope of the radar pulse is retrieved following reflection and examined for distortion. The shape of the reflected dc pulse is also determined. Pulse distortion resulting from multiple reflections is easily formulated by constructing a composite transfer function consisting of the product of reflection coefficients and retardation factors. (Author)

A70-33023 Design considerations of laser strain meters. J. Berger (California, University; San Diego, Calif.). In: Laser applications in the geosciences; Douglas Advanced Research Laboratories, Symposium, Huntington Beach, Calif., June 30-July 2, 1969, Proceedings. Edited by J. Gauger and F. F. Hall, Jr. North Hollywood, Calif., Western Periodicals Co., 1970, p. 203-213. 15 refs. ESSA Grant No. E-150-68(G).

Discussion of laser devices which measure the change in length of some base length for earth strain measurement applications. Wavelength stabilization is considered taking into account two broad categories of laser wavelength stabilizers. An equal path length strain meter is discussed and methods of observing the fringes are described. G.R.

A70-33024 * Absolute strain measurements with a 30 meter vacuum interferometer. H. S. Boyne, J. L. Hall, R. L. Barger, P. L. Bender, J. Ward, J. Levine, and J. Faller (Joint Institute for Laboratory Astrophysics, Boulder, Colo.). In: *Laser applications in the geosciences; Douglas Advanced Research Laboratories, Symposium, Huntington Beach, Calif., June 30-July 2, 1969, Proceedings.* Edited by J. Gauger and F. F. Hall, Jr. North Hollywood, Calif., Western Periodicals Co., 1970, p. 215-225. 5 refs. NASA-supported research.

Discussion of the design and performance of a 30 m interferometric strain gauge and of a practical method for recording absolute earth strain measurements by comparing length changes in the interferometer with an absolute wavelength standard. The strain gauge system consists of a pair of 50 m radius of curvature mirrors mounted inside vacuum boxes at each end of a 30 m vacuum envelope. The interferometer is excited by a He-Ne laser operating at 633 nm. G.R.

A70-33170 The measurement of surface temperature with an IR scanning imager. P. J. Walsh and R. J. Spencer (Lockheed Electronics Co., Houston, Tex.). In: *Electro-Optical Systems Design Conference, 1st, New York, N.Y., September 16-18, 1969, Proceedings.* Edited by K. A. Kopetzky. Chicago, Industrial and Scientific Conference Management, Inc., 1970, p. 533-543. 7 refs.

Brief description of the principles involved in measuring surface temperature with an infrared scanning imager. The system is mounted in an aircraft and scans the terrain below through an opening in the airframe. An infrared scanning imager is a power sensor (photon counter). It does not respond directly to surface temperature, but to the power received at the collecting optics of the sensor. The factors affecting the power incident upon an instrument aperture are examined, and the way by which instrument outputs may be related to the real thermodynamic temperature of a terrain surface element are outlined. An analytical technique for interpreting the data output is described. F.R.L.

A70-33227 # Use of spectrophotometric characteristics of objects for automation of aerial photo interpretation (Ispol'zovanie spektrofotometricheskikh kharakteristik ob'ektov dlia avtomatizatsii deshifirovaniia aerosnimkov). K. E. Meleshko. *Geodeziia i Aerofotos'emka*, no. 2, 1969, p. 69-72. In Russian.

Description of an aerospectrometric camera designed to facilitate the determination of the spectral brightness coefficients of the objects to be identified. The proposed aerial photo camera, which can operate with or without a divider, consists of an optical unit (including a terrain scanning device, a bichromator, and a receiver/amplifier system), a computer, a main indicator and control indicator unit, and a traveling-film recorder. The geometrical resolution of the camera is 10 lines per millimeter. A.B.K.

A70-34046 ERTS-A satellite imagery. Alden P. Colvocoresses (U.S. Geological Survey, Washington, D.C.). *Photogrammetric Engineering*, vol. 56, June 1970, p. 555-560. 9 refs.

Discussion of an earth-sensing space system, termed an earth resources technology satellite (ERTS-A), designed to provide data for the Interior Department's Eros (earth resources observation satellite) program and other programs involving the survey of earth's resources. ERTS-A will produce telemetered imagery that must be spatially correlated to the earth's surface. This spatial relationship is derived from the orbital-position and sensor-attitude data provided by existing telemetry satellites. If the imagery is obtained under specified conditions, then the image displacements caused by the earth's curvature, atmospheric refraction, camera obliquity, and terrain relief, as well as scale errors due to map projection, are negligible. The imagery is then an accurate map, subject only to the internal distortions and resolution limitations of the imaging system. V.P.

A70-34183 Spectrophotometric studies of atmospheric transmittance and stability. B. T. Tashenov. (*Atmosfera Optika;*

Akademiia Nauk SSSR, Soveshchanie po Atmosfernoi Optike, Pulkovo, USSR, November-December 1965 and December 1966, Trudy, p. 75-86.) In: *Atmospheric optics.* Edited by N. B. Divari. (Translation of *Atmosferaia optika*, Moscow, Izdatel'stvo Nauka, 1968.) New York, Plenum Publishing Corp., 1970, p. 70-79. 5 refs.

Results of observations of the spectral transparency and stability of the atmosphere in the 410 to 735-mμ spectral region, carried out on a photoelectric spectrophotometer at an altitude of 1450 m above sea level at the Observatory of the Astrophysical Institute of the Academy of Sciences of the Kazakh SSR. A method proposed by Piaskovskaia-Fesenkova (1957) and based on measuring the solar aureole brightness is found to be completely effective throughout the visible spectral region in the presence of snow-covered or grassy underlying surfaces. Extensive tabulated data obtained from measurements made in 1964 and 1965 are presented. Periods of stable, quasi-stable, and unstable atmospheric transparency are established. V. Z.

A70-34312 # Television systems for Earth Resources Satellite. Herbert M. Gurk (RCA, Astro-Electronics Div., Princeton, N.J.). (*British Interplanetary Society and NATO, International Summer School on Earth Resources Survey Satellites, Gonville and Caius College, Cambridge, England, July 14-25, 1969, Paper.*) *British Interplanetary Society, Journal*, vol. 23, July 1970, p. 469-486. 10 refs.

Brief description of all aspects of television system usage for an earth resources satellite (ERS). Various ERS television camera configurations, the characteristics of the return-beam vidicon camera, and devices to reproduce the television pictures on film on the ground are described. Other requirements for a ground data handling system for these pictures and an initial ground system concept are developed, the image processing requirements for various applications are described, and the future of television for remote sensing is discussed. M.M.

A70-34539 * A new concept of cosmic gamma rays near 1 MeV observed by the ERS-18. James I. Vette (NASA, Goddard Space Flight Center, Greenbelt, Md.), Duane Gruber, James L. Matteson, and Laurence E. Peterson (California, University, San Diego, Calif.). *Astrophysical Journal*, vol. 160, June 1970, pt. 2, p. L161-L170. 16 refs. ARPA-sponsored research.

Discussion of new data on the total omnidirectional flux of cosmic gamma-rays ranging from 0.25 to 6 MeV obtained by the Environmental Research Satellite 18. The measurements indicate that in the range from 1 to 6 MeV there is an additional component of gamma rays above that expected by simple extrapolation of the spectrum below 1 MeV to higher energies. Z.W.

A70-35622 * How multispectral sensing can help the ecologist. Fabian C. Polcyn, Norma A. Spansail, and William A. Malida (Michigan, University, Ann Arbor, Mich.). In: *Remote sensing in ecology; Ecological Society of America and American Society of Limnology and Oceanography, Symposium, Madison, Wis., June 19, 1968, Proceedings.* Edited by P. L. Johnson. Athens, Ga., University of Georgia Press, 1969, p. 194-218. 10 refs. Research supported by the U.S. Department of the Interior, the U.S. Department of Agriculture, the Arctic Institute of North America, the U.S. Army, the Tennessee Valley Authority, the U.S. Navy, and NASA.

Consideration of the potential of multispectral remote sensing for ecological research, which lies in its ability to provide information about an object without necessarily resolving its spatial properties. In order to accomplish this form of data collection reliably, new calibrated, synchronized, multichannel sensors are being developed. Results thus far show that whenever spectral differences occur and can be related to a parameter of interest about an object, multispectral sensing can aid in its detection, the mapping of its distribution, or the analysis of its energy budget characteristics. A wide variety of special signal processing techniques are available to aid in the recognition and mapping of objects of interest and the measurement of energy budget parameters. F.R.L.

08 INSTRUMENTATION AND SENSORS

A70-35932 # Meteorological application of satellite window radiation. Kong Sam Pak (Meisei Denki Co., Ltd., Tokyo, Japan). *Journal of Applied Meteorology*, vol. 9, June 1970, p. 521-529. 20 refs.

Study of the 8 to 12 micron band of window radiation data from Tiros 2, 3, and 4 were used in raw and modified form. The data were segregated into four groups, representing measurement of surface temperatures on land and sea by day and night. A three-day period (Feb. 10 to 12, 1962), when a 'Shanghai low' predominated over Korea and Japan, was chosen for the detailed discussion. Results were tested for the United States in summer and applied to estimations of cloud top temperatures, cloud top heights, and vertical motion in overcast areas, and inversion top temperatures in areas of clear skies. Analysis of the modified data indicated good correlation with sky conditions, 700-mb vertical motion, and 500-mb vorticity advection. The resolution of the radiometer was investigated for cloudy areas. Satellite radiation data can provide an additional source of valuable synoptic information that can be used directly in the numerical prediction process. (Author)

A70-36558 The airborne infrared scanner as a geophysical research tool. Jules D. Friedman (U.S. Geological Survey, Washington, D.C.). *Optical Spectra*, vol. 4, June 1970, p. 35-44. 22 refs.

Consideration of the infrared scanner as an effective anomaly-mapping tool, which depicts surface emission directly and heat mass transfer from depths only indirectly and at a threshold level 50 to 100 times the normal conductive heat flow of the earth. Successive terrain observations are affected by time-dependent variables such as the diurnal and seasonal warming and cooling cycle of a point on the earth's surface. In planning precise airborne surveys of radiant flux from the earth's surface, account must be taken of background noise created by variations in micrometeorological factors and emissivity of surface materials, as well as the diurnal temperature cycle. The effect of the diurnal cycle may be minimized by planning predawn aerial surveys. F.R.L.

A70-36941 # Quartz H-magnetometer. V. N. Bobrov (Akademii Nauk SSSR, Institut Zemnogo Magnetizma, Ionosfery i Rasprostraneniia Radiovoln, Krasnaya Pakhra, USSR). (*Geomagnetizm i Aeronomiia*, vol. 9, no. 6, 1969, p. 1134-1136.) *Geomagnetism and Aeronomy*, vol. 9, no. 6, 1969, p. 922-924. Translation.

Description of an experimental specimen of a quartz magnetometer designed to measure the horizontal component of the geomagnetic field. Essential in the device is a solid quartz frame whose suspension system includes a static magnet and is suspended on untwisted vertical threads. Two magnets are attached rigidly to the frame so as to produce a magnetic field in the center of the static magnet. Good stability of the H(zero) constant of the device is observed during a trial operation period of 5 months. V.Z.

A70-38262 * # Remote sensing of atmospheric ozone using the 9.6-micron band. C. Prabhakara, B. J. Conrath, R. A. Hanel (NASA, Goddard Space Flight Center, Greenbelt, Md.), and E. J. Williamson (Oxford University, Oxford, England). *Journal of the Atmospheric Sciences*, vol. 27, July 1970, p. 689-697. 20 refs.

Use of spectral measurements made by a high resolution Infrared Interferometer Spectrometer (IRIS) aboard the Nimbus 3 satellite to deduce, remotely, atmospheric ozone content and distribution. This indirect method depends on the emission and absorption properties of ozone in the 9.6-micron region, as well as some gross climatological properties of the vertical ozone profile. Several IRIS spectra have been analyzed, and the corresponding vertical ozone distributions are determined. A comparison of ozone soundings made by chemical sounders with those derived from the satellite data shows relatively good agreement of gross features. The total ozone estimated from the derived profiles compares well with the measured total. This study shows that the atmospheric total ozone content can be determined, with the help of IRIS spectra, over a large part of the globe, with an accuracy of about plus or minus 6% compared to values derived from Dobson's measurements. (Author)

A70-39052 * Flame type imaging sensors. George Barna (RCA, Astro-Electronics Div., Princeton, N.J.). In: Princeton University, Conference on Aerospace Methods for Revealing and Evaluating Earth's Resources, Princeton University, Princeton, N.J., September 25, 26, 1969, Proceedings. Edited by J. P. Layton. Princeton, N.J., Princeton University Conference, 1970, p. 1.1-1.18; Discussion, p. 1.19, 1.20. Contract No. NAS 5-11621.

Discussion of the salient features of space TV cameras and of television systems currently being developed for first generation earth resource satellite missions. Requirements unique to cameras for space applications are examined. It is pointed out that these requirements are best met with a vidicon as the sensing element. Criteria important in selecting a vidicon for space usage are investigated. The requirements for an earth resources mission are examined, and suitable earth resources TV system designs are discussed. G.R.

A70-39053 Scanning type imaging sensors. Virginia T. Norwood (Hughes Aircraft Co., Los Angeles, Calif.). In: Princeton University, Conference on Aerospace Methods for Revealing and Evaluating Earth's Resources, Princeton University, Princeton, N.J., September 25, 26, 1969, Proceedings. Edited by J. P. Layton. Princeton, N.J., Princeton University Conference, 1970, p. 2.1-2.6; Discussion, p. 2.7, 2.8.

Discussion of satellite orbits and scanners which will best perform certain earth resources imaging tasks. The devices for multispectral imaging and their capabilities from suitable orbits are discussed. The design of a multispectral spin scanner and of a multispectral scanner for an earth resources satellite are described. Diffraction and attitude limitations on resolution are examined, and a number of imaging missions are listed. G.R.

A70-39054 * Passive microwave sensors. Warren Hovis (NASA, Goddard Space Flight Center, Greenbelt, Md.). In: Princeton University, Conference on Aerospace Methods for Revealing and Evaluating Earth's Resources, Princeton University, Princeton, N.J., September 25, 26, 1969, Proceedings. Edited by J. P. Layton. Princeton, N.J., Princeton University Conference, 1970, p. 3.1-3.9; Discussion, p. 3.10, 3.11.

Discussion of passive microwave sensors taking into consideration a calculated model which shows brightness temperature vs frequency from about one to two GHz to 60 for four different atmospheric conditions. The emissivity of various materials encountered is considered. Work conducted with aircraft instruments is discussed and problems presented by surface roughness are investigated. Pictures are presented showing vegetation surrounding the Wabash river in microwave, parts of Los Angeles, and the Salton Sea. G.R.

A70-39055 Correlation spectrometry applied to earth resources. Anthony R. Barringer (Barringer Research, Ltd., Toronto, Canada). In: Princeton University, Conference on Aerospace Methods for Revealing and Evaluating Earth's Resources, Princeton University, Princeton, N.J., September 25, 26, 1969, Proceedings. Edited by J. P. Layton. Princeton, N.J., Princeton University Conference, 1970, p. 4.1-4.37.

Discussion of the whole field of earth resources as applied to mineral and oil exploration, and of correlation spectrometry as applied to earth resources taking into consideration also the subject of pollution. Aspects of air pollution in North America and in Europe are described, and problems of finding new mineral resources are considered. The importance of satellites for exploration and for the fight against pollution is discussed. The health effects of sulfur dioxide pollution are investigated. The occurrence of mineral resources is discussed, and a number of applications of correlation spectrometers are considered including sulfur dioxide, nitrogen oxide, and iodine surveys. G.R.

A70-39056 * Manned systems for sensing earth's resources. John E. Dornbach (NASA, Manned Spacecraft Center, Earth Observations Div., Houston, Tex.). In: Princeton University, Con-

ference on Aerospace Methods for Revealing and Evaluating Earth's Resources, Princeton University, Princeton, N.J., September 25, 26, 1959, Proceedings. Edited by J. P. Layton. Princeton, N.J., Princeton University Conference, 1970, p. 6.1-6.13, 6.15, 6.17, 6.19, 6.21-6.23, 6.25-6.33; Discussion, p. 6.34, 6.35.

Discussion of earth resources data which has come, is coming, and potentially can come from sensor and data handling systems functioning in aircraft and spacecraft operated by men. Single-camera and multiband systems from the Gemini and Apollo programs are considered. The development of remote sensor techniques is discussed. A number of photographs mostly taken from Apollo 9 are presented. The earth resources aircraft project is considered and the Apollo Applications Program is examined. Studies undertaken in connection with the proposed manned space station/base are reported. G.R.

A70-39057 * Unmanned spacecraft for surveying earth's resources. Theodore A. George (NASA, Washington, D.C.). In: Princeton University, Conference on Aerospace Methods for Revealing and Evaluating Earth's Resources, Princeton University, Princeton, N.J., September 25, 26, 1969, Proceedings.

Edited by J. P. Layton. Princeton, N.J., Princeton University Conference, 1970, p. 7.1-7.9; Discussion, p. 7.10-7.12.

Discussion of the current status of the program for surveying earth's resources taking into consideration also the history of the program and an outlook into the future. Several alternatives considered during the development of the earth resources satellite are discussed. The basic objectives of the first two ERTS satellites are examined. The payload of the satellites is described. Performance characteristics are considered, and ground station considerations are investigated. G.R.

A70-39076 * # Visible and infrared imagery from meteorological satellites. W. E. Shenk and V. V. Salomonson (NASA, Goddard Space Flight Center, Greenbelt, Md.). *Applied Optics*, vol. 9, Aug. 1970, p. 1747-1760, 242 refs.

Review of the road of scientific progress of the past decade in the field of global visible and infrared measurements by means of meteorological satellites. Following a brief outline of the evolution of the satellite visible and infrared instrumentation, the results of the various types of measurements performed by meteorological satellites are summarized. They include remote surface temperature measurements, measurements of atmospheric state parameters, storm development and tracking, general circulation of the atmosphere, cloud motions and characteristics, and detecting natural resource boundaries and characteristics. O.H.

A70-39128 Multispectral photography in earth resources research. D. T. Hodder (North American Rockwell Corp., Civil Unmanned Systems Dept., El Segundo, Calif.). *Optical Spectra*, vol. 4, July-Aug. 1970, p. 71-75.

Evaluation of the multispectrographical technique, which has inherent advantages over conventional photography in many earth science applications. Preliminary work by NASA, the Department of the Interior, and other organizations indicates that a multiband camera system using three spectral bands (475-575, 580-680, and 690-830 nm) appears to be the most useful initial system for satisfying the greatest number of applications areas. As a result, an equivalent vidicon camera system (three return beam vidicons) has been selected for the Earth Resources Technology Satellites (ERTS) A and B currently under development by NASA. F.R.L.

A70-39793 * Theory, applications, and results of the long-line correlation spectrometer. Gilbert S. Newcomb (Environmental Measurements, Inc., San Francisco, Calif.) and Millán Muñoz Millán (Barringer Research, Ltd., Toronto, Canada). *IEEE Transactions on Geoscience Electronics*, vol. GE-8, July 1970, p. 149-157. Research

supported by the National Research Council, the American Iron and Steel Institute, and NASA.

Examination of the techniques of correlation spectroscopy as applied to the remote sensing of air polluting gases SO₂ and NO₂. The occurrence of molecular absorption of solar and artificial electromagnetic radiation is used to determine the quantitative value of the gases over a long-line length. The instrument's principles of operation, applications of a portable remote sensing system, and results for the long-line determinations of SO₂ and NO₂ quantities are described. The system and application techniques presented are in consideration of minimizing distortion and interfering factors that are inherently present in solar radiation. The remote sensing long-line system that is portable is significant to air pollution monitoring, because it adds accurate quantitative dimension to the usual point sampling methods of measurement. M.M.

A70-39794 * Automatic measurement of drainage networks. Roger M. McCoy (Kentucky, University, Lexington, Ky.). *IEEE Transactions on Geoscience Electronics*, vol. GE-8, July 1970, p. 178-182. 5 refs. Contract No. NSR-17-004-003; Grant No. NSG-298.

Two methods for measuring network lengths and areas by automatic methods are discussed. Results of experiments using drainage networks are presented and indicate that further study and refinement are warranted. The first method involves etching the network on a copper plate and measuring its capacitance. The capacitance of each network plate is shown to have a strong association with the total length of the stream network. The second method uses a flying-spot scanner on either hand-drafted transparencies or directly on radar images. Data obtained by measurement of the edge-enhanced lines marking film-density boundaries show a high correlation with the total length of stream networks. Application of this latter method would permit acquisition of terrain data from large areas in a very short time. (Author)

A70-40697 * The cosmic gamma-ray spectrum near 1 MeV observed by the ERS-18 satellite. James I. Vette (NASA, Goddard Space Flight Center, Greenbelt, Md.), Duane Gruber, James L. Matteson, and Laurence E. Peterson (California, University, La Jolla, Calif.). In: Non-solar X- and gamma-ray astronomy; International Astronomical Union, Symposium, Rome, Italy, May 8-10, 1969, Proceedings. Symposium supported by the Consiglio Nazionale delle Ricerche. Edited by Livio Gratton. Dordrecht, D. Reidel Publishing Co. (IAU Symposium No. 37), 1970, p. 335-341, 18 refs.

Discussion of new data on the total, or omnidirectional, cosmic gamma-ray flux in the 250 keV to 6 MeV range obtained during May and June 1967, by the Environmental Research Satellite-18. ERS-18 counting rates obtained with the anticoincidence shield turned on and off are tabulated and plotted as a function of energy. Data on the total cosmic background spectra over the 250 eV to 100 MeV resulting from various measurements, and the results of computation in which a theoretical power law spectrum and a red-shifted spectrum corresponding to a Stecker model of $Z = 100$ were inputted to a Monte Carlo program which takes into account the detector response at all energies, are presented. The resultant energy loss spectrum is compared with the ERS-18 data. O.H.

A70-40905 * # Atmospheric and surface properties from spectral radiance observations in the 4.3-micron region. J. H. Shaw (Ohio State University, Columbus, Ohio), M. T. Chahine, C. B. Farmer, L. D. Kaplan, P. W. Schaper (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.), and R. A. McClatchey (USAF, Cambridge Research Laboratories, Bedford, Mass.). *Journal of the Atmospheric Sciences*, vol. 27, Aug. 1970, p. 773-780, 10 refs. Contract No. NAS 9-7218.

Atmospheric temperature profiles, obtained from spectral radiances of the earth between 4.2 and 4.6 microns measured by a balloonborne, multi-detector, grating spectrometer at 3.5 mb during a 6-hr flight, are described. Representative profiles obtained both before and after sunrise and for clear and cloudy skies show that

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atmospheric temperatures accurate to about 2 deg K can be inferred. The variations of surface temperature during the flight are discussed. (Author)

A70-40943 Recording gravity waves by means of geostationary beacon-satellites. W. Dieminger, J. P. Schödel, G. Schmidt, and G. K. Hartmann (Max-Planck-Institut für Aeronomie, Lindau über Northeim, West Germany). *Journal of Atmospheric and Terrestrial Physics*, vol. 32, Sept. 1970, p. 1615-1617. Ministry for Education and Research Grants No. WRK 125; No. WRK 153.

Demonstration that geostationary beacon-satellites are a useful means for recording the influence of gravity waves on the total electron content of the ionosphere. By differentiation of electron content with respect to time the gravity waves become clearly visible, especially during those parts of the electron content-record with steep increases or decreases which obscure the effect of gravity waves. (Author)

A70-41871 # Comparison of basic modes for imaging the earth. Alden P. Colvocoresses (U.S. Geological Survey, McLean, Va.). (American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-294.) *Journal of Spacecraft and Rockets*, vol. 7, Sept. 1970, p. 1129-1131.

Discussion of the more obvious characteristics of each of four basic modes for imaging the earth. The airborne mode considered is concerned with imaging systems carried by aircraft, balloon or similar platform within the atmosphere. The NASA-designated flights of ERTS A and B exemplify the data-transmission space mode from moderate (300 to 900 km) altitude. Earth-sensing flights in the film-return mode last only a few weeks and do not attempt to provide near-real-time information. The geosynchronous mode involves a satellite at a distance of 20,000 miles which continuously hovers over the same area of the earth. G.R.

A70-42121 # A regression method for obtaining real-time temperature and geopotential height profiles from satellite spectrometer measurements and its application to Nimbus 3 SIRS observations. W. L. Smith, H. M. Woolf, and W. J. Jacob (ESSA, Washington, D.C.). *Monthly Weather Review*, vol. 98, Aug. 1970, p. 582-603. 14 refs.

Development of a least squares regression method for obtaining global temperature and geopotential-height profiles from satellite radiation measurements. Regression equations relating temperature and geopotential height to spectral radiance observations are derived. A method accounting for the influence of clouds, mountains, and hot terrain on the solutions is proposed. Results obtained on a real-time basis from radiance data recorded with the satellite IR spectrometer (SIRS) on board the Nimbus 3 satellite are presented. V.P.

A70-43087 # MSDS - An experimental 24-channel multispectral scanner system. E. M. Zaitzeff, C. L. Wilson, and D. H. Ebert (Bendix Corp., Aerospace Systems Div., Ann Arbor, Mich.). *Bendix Technical Journal*, vol. 3, Summer-Autumn 1970, p. 20-32.

Description of a multispectral scanner system designed for use in earth-resources survey programs. An extension of the infrared scanner, with which large numbers of wavelength bands can be observed simultaneously in registration, it will collect both spectral and spatial information on the terrain scanned. This scanner will be capable of viewing simultaneously 24 wavelength bands in the range between 0.34 and 13 micrometers. It will have a spatial resolution of 2 milliradians and an active scan angle of 80 degrees. The spectral bands are formed by detector arrays in the focal plane of two grating spectrometers. All bands are radiometrically calibrated, using field-filling sources that are viewed during the inactive part of the scan cycle. The scanner will be installed and test-flown during the latter part of 1970. M.V.E.

A70-43558 # A vertical optical gyro (Giroopticheskaya vertikal'). A. A. Babaev (Moskovskii Tekhnologicheskii Institut, Moscow, USSR). *Prirodaostroenie*, vol. 13, no. 6, 1970, p. 80-85. In Russian.

Consideration of an airborne optical scanning apparatus intended for studies of the radiation emitted by a sea surface. It is suggested that the gyroscopic stabilizer unit be eliminated from a device with an optomechanical unit for scanning along a cone generatrix and that the scanning unit be used as an astatic gyroscope to construct a vertical. The principle of this arrangement is verified on a bench model. A kinematic diagram and photographs of the experimental model are presented. A.B.K.

A70-43663 Helicopter gravity measuring system. William R. Gumert and Glen E. Cobb (U.S. Army, Topographic Command, Washington, D.C.). In: *Advances in dynamic gravimetry; Proceedings of the Symposium on Dynamic Gravimetry, Fort Worth, Tex., March 16, 17, 1970.* Edited by W. T. Kattner. Pittsburgh, Instrument Society of America, 1970, p. 79-84; Discussion, p. 84, 85.

Description of the development of an efficient integrated helicopter gravity measuring system and its testing under a variety of operating conditions. This system consists of a stable-platform gravity meter, a laser altimeter, a pressure port calibrator, a 35-mm strip camera or IR scanner, a HIRAN navigational system, a digital logger, and the necessary interface and analog recording monitors. This system was installed in November 1968 in a helicopter. Approximately 100 flight hours were performed over a 2-1/2 month period. Three blocks of data were given special attention: rolling terrain, a continental slope area, and a rugged region in the Appalachians around Luray Caverns. Z.W.

A70-43855 * Some spectrometric results from the NASA 1968 airborne auroral expedition. K. A. Dick (Kitt Peak National Observatory, Tucson, Ariz.). *Journal of Geophysical Research*, vol. 75, Oct. 1, 1970, p. 5605-5608. 12 refs. Grant No. NGR-21-001-001.

Spectrophotometer measurements taken aboard NASA's 1968 airborne auroral expedition included measurements of numerous weak auroral features. The ratio of the intensities of the permitted O I line at 4368 Å and of the N₂+ 1NG (0,1) band at 4278 Å was 1:60 under a variety of auroral conditions. The forbidden N I line at 3486 Å varied in intensity relative to the 4278-Å band. Its variation follows O I 8300 Å, and it may be used as an indicator of precipitating electron energy changes. The continuum at 6700 Å was found to have a value less than 1/2 R/A in an area through which an arc had recently passed. A technical report (Technical Report 24, Department of Physics, Johns Hopkins University) that gives details of results at the disposal of other experimenters will soon be available. (Author)

A70-44035 # Determination of the earth's surface temperature from remote spectral radiance observations near 2600 per cm. J. H. Shaw (Ohio State University, Columbus, Ohio). *Journal of the Atmospheric Sciences*, vol. 27, Sept. 1970, p. 950-959. 15 refs. NASA-supported research.

Description of methods of determining the spectral brightness temperature, the spectral directional emissivity, and the actual temperature of the earth's surface, and of clouds, from observations of the earth's spectral radiance between 2500 and 2655 per cm. These methods have been used to obtain nighttime and daytime surface temperatures and daytime cloud top temperatures from earth radiances measured by a balloon-borne multidetector grating spectrometer. The computed temperatures have been verified by comparison with other data. (Author)

A70-44636 # Spectrophotometry of the earth from manned spacecrafts. K. Ia. Kondrat'ev, A. A. Buznikov, L. I. Chapurskii, V. V. Gorbatko, A. A. Grigor'ev, A. G. Nikolaev, V. M. Orlov, Iu. I. Rabinovich, V. I. Sevastianov, O. T. Smokty, O. B. Vasil'ev, B. V. Vinogradov, and V. N. Volkov. *International Astronautical Federa-*

tion, *International Astronautical Congress, 21st, Konstanz, West Germany, Oct. 4-10, 1970, Paper. 15 p. 8 refs.*

Review of the scientific experiments conducted from the manned Soyuz 6, 7, and 9 spacecraft, which included photography and spectrophotometry of the earth's surface along the route Caspian Sea-Ust'-Urt-Aral Sea, and in other areas. In order to obtain information on the transfer function of the atmosphere, aircraft flights were performed along the same route. The aircraft were equipped with instruments similar to those installed on the manned spacecraft. At the same time surface groups performed a physical-geophysical description of the surface along the flight route. It is noted that every method of remote sensing gives specific but limited and often insufficiently reliable information about the state of the earth's surface, oceans, and atmosphere. Only combined application of a complex of methods for registering the electromagnetic field on the earth in different spectral regions, which correct and supplement one another, makes it possible to obtain sufficiently reliable, comprehensive, and detailed information on the natural environment by means of remote sensing.

F.R.L.

A70-44648 # Microwave radiometry and its applications. Philip J. Caruso, Jr. (Spectran, Inc., Hollywood, Calif.). *International Astronautical Federation, International Astronautical Congress, 21st, Konstanz, West Germany, Oct. 4-10, 1970, Paper. 29 p.*

Discussion of microwave radiometry and its applications for aircraft navigation and landing aids, pollution surveillance, meteorology, and oceanology. It is pointed out that microwave radiometry is extremely sensitive to the composition of the material as well as its thermometric temperature. The apparent temperatures from various materials which might be observed when looking at the earth from a satellite are discussed. Examples of the application of microwave radiometry in space are considered, and a summary of the various uses of microwave radiometry for meteorological data is given. A completely designed multibeam scanner which could be used as a low-visibility landing aid is described.

G.R.

A70-44633 # Thermal emission spectra of the earth and atmosphere from the Nimbus 4 Michelson interferometer experiment. R. A. Hanel and B. J. Conrath (NASA, Goddard Space Flight Center, Greenbelt, Md.). *Nature*, vol. 228, Oct. 10, 1970, p. 143-145.

Discussion of preliminary results which show that the interferometer experiment on Nimbus 4 is providing high quality IR spectra of the earth and atmosphere. Profiles of atmospheric temperature, humidity, and ozone are recovered from the thermal emission spectra in the interval 400 to 1600 per cm obtained with the Nimbus 4 satellite. Selective spectra obtained over the Sahara Desert, the Mediterranean and the Antarctic are shown. It is pointed out that low-noise-equivalent radiance, high spectral resolution, and broad spectral coverage make the data of the interferometer experiment on Nimbus 4 ideally suited for studies of atmospheric radiative transfer as well as the analysis and development of remote-sensing techniques.

G.R.

A70-45007 Remote detection of solar stimulated luminescence. W. R. Hemphill (U.S. Geological Survey, Washington, D.C.). In: *International Astronautical Federation, Congress, 19th, New York, N.Y., October 13-19, 1968, Proceedings. Volume 1 - Spacecraft systems.* Edited by Michal Łunc. Oxford, Pergamon Press, Ltd.; Warsaw, Państwowe Wydawnictwo Naukowe, 1970, p. 161-172. 8 refs.

Results of preliminary outdoor tests with a high-resolution grating spectrometer, which have established the feasibility of detecting luminescent materials by means of the so-called Fraunhofer line-depth method. This method is advantageous because it uses the sun as an excitation method and is therefore independent of low-powered artificial sources such as cathode ray tubes, lasers, and mercury vapor lamps. Ground tests show that the technique can be used to distinguish Rhodamine dye in concentrations of less than 5 ppb, and the technique appears to be most promising in water resources and pollution studies. The technique may also be

applicable to studying luminescence components in the earth's atmosphere from orbiting satellites.

F.R.L.

A70-45350 # Magnetic field and electron observations near the magnetopause. K. W. Ogilvie, J. D. Scudder, and M. Sugiura (NASA, Goddard Space Flight Center, Greenbelt, Md.). *International Astronomical Union, International Association of Geodesy, International Union of Radio Science, and COSPAR, International Symposium on Solar-Terrestrial Physics, Leningrad, USSR, May 11-20, 1970, Paper. 28 p. 28 refs.*

Observations of electron fluxes at energies between 25 eV and 130 eV by the triaxial electron spectrometer onOGO-E, and of the magnetic field by the magnetometer on the same satellite, are used to study the magnetopause at quiet and at fairly disturbed times. They indicate that the boundary, whose thickness of order 100 km is sometimes resolved, is either at rest or moving with a speed of the order of several kilometers per second with an amplitude of 1 to 2 earth radii. Pressure balance indicates that beta in the magnetosphere close to the boundary is frequently of order unity. This in turn indicates the presence of plasma adjacent to the magnetopause on the dawn side, in agreement with other observers.

(Author)

A70-45974 # Spacecraft sensor trends in the '70's. Carl L. Kober (Martin Marietta Corp., Denver, Colo.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 7th, Houston, Tex., Oct. 19-22, 1970, Paper 70-1291. 11 p. Members, \$1.50; nonmembers, \$2.00.*

Spacecraft sensor trends for the '70's are derived from the research and technology requirements for the Space Station. They range from astronomy, biomedicine and biology, earth resources, and space physics to spacecraft technology. Sensor requirements as classified into research, advanced technology, and development, spanning a seven-year cycle are determined and the main representative trends are listed.

(Author)

A71-10917 * Manned Space Flight Network Telemetry System. Thomas C. Underwood, Jr. (NASA, Goddard Space Flight Center, Telemetry Engineering Section, Greenbelt, Md.). In: *International Foundation for Telemetering, International Telemetering Conference, Los Angeles, Calif., October 13-15, 1970, Proceedings.*

Conference co-sponsored by the Instrument Society of America and Electronic Industries Association. Woodland Hills, Calif., International Foundation for Telemetering (ITC Proceedings, Volume 6), 1970, p. 502-527. 12 refs.

This paper discusses the Manned Space Flight Network (MSFN) Telemetry System as it has been developed through the Mercury, Gemini, and Apollo programs and is now being modified to meet Skylab, Earth Resources Technology Satellite (ERTS), and Apollo 'J' mission (Apollo 16 and subsequent lunar missions) requirements. The existing telemetry system must be modified to meet the requirements of these future programs. This modification will consist of the implementation of automated configuration switching, centralized control of telemetry subsystems, tunable FM and PSK modulators/demodulators, high frequency PCM signal conditioners, and the upgrading of both the wide band instrumentation magnetic tape recorders and the PCM decommutation capability. The resulting telemetry system, which will be capable of supporting various manned and unmanned space missions, is described here. Data flow diagrams are delineated and equipment electrical characteristics are discussed.

(Author)

A71-11249 # Global distribution of ozone from Nimbus III. C. Prabhakara and B. J. Conrath (NASA, Goddard Space Flight Center, Greenbelt, Md.). *COSPAR, Plenary Meeting, 13th, Leningrad, USSR, May 20-29, 1970, Paper. 17 p. 6 refs.*

A method to invert the radiance measurements made by the Infrared Interferometer Spectrometer (IRIS) on board the Nimbus 3 satellite is developed to deduce the vertical distribution and, thereby, the total amount of atmospheric ozone. The standard error of total ozone amount derived from this method is about 6% with respect to

'Dobson' measurements. The satellite-observed total ozone distribution on the globe shows a close relationship with the tropospheric weather systems. Generally low values of total ozone are found in the equatorial belt, and the values increase toward the poles. Total ozone amounts well in excess of .5 cm (STP) at Arctic regions are observed during spring. (Author)

A71-11952 SLAR imagery and site selection. David J. Barr and Robert D. Miles (Purdue University, Lafayette, Ind.). *Photogrammetric Engineering*, vol. 36, Nov. 1970, p. 1155-1170. 7 refs.

Discussion of a systematic side-looking airborne radar (SLAR) interpretation procedure designed for regional engineering site selection studies. SLAR imagery is shown to provide a synoptic display of terrain at small scale (1/100,000 or smaller) for regional site selection studies. SLAR imagery obtained to maximize directional trends of the landscape show unique patterns. A systematic procedure of pattern analysis has been developed using a data evaluation guide, and the determination on the imagery of discrete tonal elements, average areal tone and image texture. Patterns of drainage, topography, vegetation, and cultural features are analyzed to classify land form types. Inferences on the geological and engineering soil conditions affecting site selection are based on the genetic and morphological land form types classified on the SLAR imagery. The techniques discussed are applicable to the determination of corridors in remote areas of the world. The specific routes or paths within corridors are analyzed by the use of large-scale aerial surveys. O.H.

A71-12332 * A one-bit VLBI recording and playback system using videotape recorders. R. D. Michelini (Smithsonian Astrophysical Observatory, Cambridge, Mass.). *Radio Science*, vol. 5, Oct. 1970, p. 1263-1270. Contract No. NSR-09-015-079.

Description of a flexible, hybrid very long baseline interferometry instrumentation system which uses videotape recorders for recording digitized data in routine geodetic and geophysical measurements. The system records data on videotape in the field and later generates conventional digital magnetic tapes for programmed correlation in a high-speed general-purpose computer. By selection of an appropriate data rate, these tapes can be made compatible with the present National Radio Astronomy Observatory-Arecibo Ionospheric Observatory (NRAO-AIO) Mk-1 format. In addition, the major components have been designed and chosen so that they can be incorporated into the Mk-2 system now being developed. This is a high-density wideband system that uses direct videotape correlation. The entire instrumentation back end is described, including the video converter, the recording system, and the computer-compatible reformatting units. Station time-keeping, which is integral with the recording format, is also discussed. T.M.

A71-12841 # Methods of the theory of random functions in gravimetric observations over water (Metody teorii sluchainykh funktsii v nadvodnykh gravimetricheskikh nabludeniiakh). S. K. Ismatkhodzhaev. Moscow, Izdatel'stvo Nauka, 1970. 190 p. 97 refs. In Russian.

Attention is given to evaluation of the dynamic accuracy of relative measurements of gravitational acceleration by gravity meters carried on surface ships whose inclinations and accelerations are random functions of time. The problem is solved with the aid of mathematical methods from the theory of random functions and its special subdivision of optimal filtration theory. Some basic characteristics of random values and random process are reviewed, and their determination from experimental data is considered. Estimation of the probabilistic characteristics of the useful signal (gravitational acceleration) and noise (inclinations) is treated in terms of methods for calculating autocorrelation functions, cross-correlation functions, and spectral density functions of random processes. Design principles of mobile gravity meters are examined, and the dynamic accuracy of instruments with linear and nonlinear damping is compared. Correlation and spectral analyses of records from instruments with single- and multiple-stage damping are demonstrated and special attention is

given to the stability of instruments with automatic compensation of changes in gravitational acceleration. Optimal linear filtration of a

A71-13420 # Study of the radio emission of the earth's surface and atmosphere on the Cosmos 243 satellite (Issledovanie radioizlucheniia poverkhnosti zemli i atmosfery na sputnike 'Kosmos-243'). A. E. Basharinov and A. S. Gurvich. *Akademiia Nauk SSSR, Vestnik*, vol. 40, Oct. 1970, p. 37-42. In Russian.

Discussion of an experiment in which thermal radio emission of the earth and the atmosphere was measured at 0.8, 1.35, 3.4, and 8.5 cm wavelengths by a four-channel radio telescope mounted on the Cosmos 243 satellite which was launched on Sept. 23, 1968, into an orbit allowing observations up to 71 deg N. Diagrams are plotted for the latitudinal distribution of temperature at the surface of the Pacific Ocean, for radioemission brightness profiles over the Arctic region, Australia and South America, and for moisture distribution over the Pacific Ocean. V.Z.

A71-14041 * Observations on the east-west asymmetry of protons trapped at low altitudes. J. B. Reagan and W. L. Imhof (Lockheed Research Laboratories, Palo Alto, Calif.). In: Space research X; COSPAR, Plenary Meeting, 12th, and Symposium on Thermospheric Properties Concerning Temperatures and Dynamics with Special Application to H and He, Prague, Czechoslovakia, May 11-24, 1969, Proceedings.

Symposium co-sponsored by the International Association of Geomagnetism and Aeronomy, the International Union of Geodesy and Geophysics, and the International Union of Radio Science. Edited by T. M. Donahue, P. A. Smith, and L. Thomas. Amsterdam, North Holland Publishing Co., 1970, p. 853-860. 21 refs. Research supported by the Lockheed Independent Research Program; Contract No. NAS 9-7030.

Measurement of the east-west asymmetry of protons trapped at low altitudes as a detailed function of B-L location. Direct observations of the fluxes and spectra of mirroring protons in the 23.5 to 80 MeV energy range were made with a high-sensitivity plastic-scintillation spectrometer aboard the Gemini 4 manned spacecraft in June 1965. On certain stabilized passes through the South Atlantic anomaly, the spectrometer was aligned essentially normal to the geomagnetic field but in an eastward or westward direction. Detailed comparison between the experimental east-to-west ratios and predictions based on proton bounce and drift-averaged atmospheric densities are made for various atmospheric and magnetic-field models. The measured asymmetries are in reasonable agreement with the predictions for an injection rate independent of position and a loss rate due to atmospheric interactions. The model differences are small compared to the magnitudes of the asymmetries and the experimental uncertainties. As expected, no asymmetry was observed in electron data obtained with the spectrometer or in the greater than 64 MeV proton data obtained from a companion omnidirectional detector. (Author)

A71-15008 Effects of the sea on radar echo from rain. Maurice W. Long and S. P. Zehner (Georgia Institute of Technology, Atlanta, Ga.). *IEEE Transactions on Aerospace and Electronic Systems*, vol. AES-6, Nov. 1970, p. 821-824. 11 refs.

Theoretical analyses are made to determine expected relative values of average radar cross section for idealized scatterers above the sea. Horizontal, vertical, and circular polarizations are considered along with various sea states and radar depression angles. The results are considered to be useful for providing insight into effects of the sea on the polarization dependence of rain return. Effects of the earth's curvature and atmospheric refraction are neglected. (Author)

A71-15762 Corrections for airborne radiation thermometry. Peter M. Saunders (Woods Hole Oceanographic Institution, Woods Hole, Mass.). *Journal of Geophysical Research*, vol. 75, Dec. 20, 1970, p. 7596-7601. 5 refs. Contract No. N 00014-66-C-0241.

Use of the PRT5 for the remote measurement of ocean surface temperature. The correction for nonblackness of the ocean ranges from +0.6 C (under clear skies) to +0.1 C (under a low overcast). From an altitude of 300 meters the correction for absorption and

emission in the intervening atmosphere can be approximated by $0.1(T - T_{\text{sub A}})$, where T is the indicated radiometric temperature and $T_{\text{sub A}}$ is the air temperature at flight level. The influence of haze is investigated experimentally and found to be small. Absolute accuracy of the measurements when made carefully from low altitude is plus or minus 0.2 C. (Author)

A71-16143 TV systems for earth resources survey satellites (Fernsehsysteme für Erderkundungs- und Erderforschungssatelliten). H. Becker. *Luftfahrttechnik Raumfahrttechnik*, vol. 16, Nov.-Dec. 1970, p. 311, 312. 8 refs. In German.

Review of the design and characteristics of satellite TV cameras and other equipment intended to meet the requirements of satellite surveys of earth resources. The high-resolution return-beam vidicon tubes designed for use in the TV camera system to be flown in a circular sun-synchronous orbit at an altitude of nearly 918.6 km are reviewed along with the laser beam image reproducer and electron beam recorder that are to complement this system. M.V.E.

A71-17126 Institute of Electrical and Electronics Engineers, Annual International Geoscience Electronics Symposium, 2nd, Washington, D.C., April 14-17, 1970, Proceedings. *IEEE Transactions on Geoscience Electronics*, vol. GE-8, Oct. 1970. 196 p.

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Geophysical dielectric constant determination. H. S. Hayre (Houston, University, Houston, Tex.), p. 289-295. 7 refs.

Portable 30-day unattended system for recording earth strain in a 66-dB range. R. C. Shopland (Teledyne, Inc., Dallas, Tex.), p. 295-305.

Impulse drive recorder. S. F. Guggenheim and N. Latner (AEC Health and Safety Laboratory, New York, N.Y.), p. 306-308.

A computer system for signal analysis at a remote terminal. J. R. Kosorok (Battelle Pacific Northwest Laboratories, Richland, Wash.), p. 309-312.

Oceanographic instrumentation.

System requirements for underwater acoustic holographic mapping. S. C. Daubin (Woods Hole Oceanographic Institution, Woods Hole, Mass.), p. 313-320.

Optical and magnetic instruments for mapping the ocean floor. C. L. Buchanan (U.S. Navy, Naval Research Laboratory, Washington, D.C.), p. 320-325.

Laser and microwave observations of sea-surface condition for fetch-limited 17- to 25-m/s winds. D. B. Ross (U.S. Navy, Naval Oceanographic Office, Washington, D.C.), V. J. Cardone (New York University, New York, N.Y.), and J. W. Conaway, Jr. (NASA, Goddard Space Flight Center, Greenbelt, Md.), p. 326-336.

Earth resources and remote sensing.

Electromagnetic depth sounder. G. T. Inouye, H. Bernstein, and R. A. Geal (TRW Systems Group, Redondo Beach, Calif.), p. 336-343.

Texture as a discriminant of crops on radar imagery. D. H. Berger (Kansas, University, Lawrence, Kan.), p. 344-348. 9 refs.

Earth-resources technology satellite - NASA Data-Processing Facility. H. H. Levy (NASA, Goddard Space Flight Center, Greenbelt, Md.), p. 348-352.

Spatial registration of multispectral and multitemporal digital imagery using fast Fourier transform techniques. P. E. Anuta (Purdue University, West Lafayette, Ind.), p. 353-368. 9 refs.

A71-17134 * Interrogation, recording, and location system. Charles E. Cote (NASA, Goddard Space Flight Center, Greenbelt, Md.). (Institute of Electrical and Electronics Engineers, Annual International Geoscience Electronics Symposium, 2nd, Washington, D.C. Apr. 14-17, 1970.) *IEEE Transactions on Geoscience Electronics*, vol. GE-8, Oct. 1970, p. 243-245.

Description of an interrogation, recording, and location system (IRLS), which is a satellite technological experiment designed to demonstrate the feasibility of determining position location and collection of scientific data from remote instrumented platforms deployed on a global scale on, or above, the surface of the earth. The system utilizes a range-range location technique which yields

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solutions as the intersection of ranging spheres; up to 28 channels of sensory data are collected with each platform interrogation. In operation, discrete addresses of platforms expected in radioview are programmed on an orbit-by-orbit basis from a central ground acquisition and command station; data retrieval is accomplished one orbit later. The results of the individual platform data collection and tracking experiments, together with an analysis of overall system performance in terms of data quality and location accuracy achieved, are described. Future experiments planned for Nimbus D are described. F.R.L.

A71-17216 # Quartz magnetometer for measuring declination and the horizontal component (Kvartsevyi magnetometr dlia izmereniia skloneniia i gorizontnoi sostavliushchei). V. N. Bobrov (Akademiia Nauk SSSR, Institut Zemnogo Magnetizma, Ionosfery i Rasprostraneniia Radiovoln, Krasnaya Pakhra, USSR). *Geomagnetizm i Aeronomiia*, vol. 10, no. 5, 1970, p. 945, 946. In Russian.

Discussion of the design and principles of operation of a quartz magnetometer which will measure simultaneously the magnetic declination and the horizontal component of the geomagnetic field. The quartz system incorporates a magnetosensitive element which uses a permanent magnet and a quartz mirror as the suspension system, a tiltmeter whose suspension system consists of a quartz mirror and a quartz rod which serves as a horizontal pendulum, and a fixed quartz mirror and two supplementary magnets which compensate for a substantial portion of the horizontal component in declination measurements. The device is particularly useful for magnetic surveys in the arctic and antarctic regions. V.P.

A71-17559 * Effects of atmospheric path on airborne multispectral sensors. Robert Horvath, John G. Braithwaite, and Fabian C. Polcyn (Michigan, University, Ann Arbor, Mich.). *Remote Sensing of Environment*, vol. 1, Dec. 1970, p. 203-215. Grant No. NSG-715.

Experimental data were acquired for a study of the effects of variable atmospheric path on the spectral signals obtained by remote sensors in the optical region of the spectrum. Multichannel optical-mechanical scanners which provide calibrated apparent spectral radiance data were flown over agricultural test sites, and passes were made at several different altitudes between 2000 and 10,000 ft. The quantitative results compare favorably with qualitative theoretical predictions. Optical-mechanical scanners and aerial photographic systems are compared to show the relative importance of potentially detrimental atmospheric path effects with regard to the operation of these systems in remote sensing. (Author)

A71-17561 * Interpretive and mosaicking problems of SLAR imagery. Anthony J. Lewis and Harold C. MacDonald (Kansas, University, Lawrence, Kan.). *Remote Sensing of Environment*, vol. 1, Dec. 1970, p. 231-236. 9 refs. Grant No. DA-AK-02-68-C-0089; Contract No. NAS 9-10261.

Discussion of the interpretive and mosaicking problems which confront the user of SLAR (side-looking airborne radars) imagery giving particular attention to slant range imagery. A typical side-looking airborne radar system operation is considered. Radar geometry and inherent limitations with SLAR imagery are discussed taking into consideration problems with the radar layover, and the radar shadow. It is recommended that for maximum geoscience data retrieval in mountainous terrain, the image output of any SLAR system should be a slant range rather than a ground range presentation. Conversely, in areas where radar layover does not present a problem, a ground range format would simplify the interpreter's task. G.R.

A71-17932 # Indirect stabilization of magnetosensitive elements on a moving object (Kosvennaia stabilizatsiia magnitochuvstvitel'nykh datchikov na dvizhushchiesia ob'ekte). S. F. Farmakovskii and L. I. Popkova (Leningradskii Institut Tochnoi Mekhaniki i Optiki, Leningrad, USSR). *Priboirostroenie*, vol. 13, no. 9, 1970, p. 76-78. In Russian.

Outline of two techniques for the measurement of geomagnetic field vector components by indirectly stabilized magnetometers which are mounted directly on a moving carrier without a mechanically stabilized platform. According to these techniques magnetometers rigidly connected directly to the carrier are used for measurements in a carrier-attached coordinate system, or a quantum magnetometer enclosed in three orthogonal pairs of Helmholtz coils rigidly attached to the carrier is used. The techniques are proposed as less mechanized alternatives to conventional techniques using stabilizing platforms with complex electromechanical equipment which produces undesirable intrinsic magnetic fields. V.Z.

A71-18287 Camera system and photogrammetry in astronautics (Kammer-Systeme und Photogrammetrie in der Raumfahrt). Frederick J. Doyle (U.S. Geological Survey, McLean, Va.). (*International Society of Photogrammetry, Symposium, Munich, West Germany, Sept. 18, 1970.*) *Bildmessung und Luftbildwesen*, vol. 39, Jan. 1, 1971, p. 6-18. 17 refs. In German.

Discussion of the plans and possibilities for the intensive use of photogrammetry in manned and unmanned space missions. Following a review of the equipment used so far for the various space programs in the past, the equipment to be used for the ensuing flights of the Apollo program to provide a photogrammetric survey of the moon's surface is described in detail. In addition, a description of a similar system proposed for the photogrammetric survey of the earth's surface from future NASA satellites is also presented. O.H.

A71-18532 # Operational capabilities of a manned space station for earth resources observation. C. A. Braunwarth, J. C. Tuttle, and C. R. Eifert (Martin Marietta Corp., Denver, Colo.). *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 9th, New York, N.Y., Jan. 25-27, 1971, Paper 71-75*. 11 p. Members, \$1.50; nonmembers, \$2.00.

This paper presents the earth resources coverage capabilities of a 'typical' manned space station and compares these capabilities with the remote measurement requirements of an extensive list of earth resources applications. Space station capability is determined through digital simulation of coverage of the State of Colorado, for various viewing angles, altitudes, inclinations, and times of year. Remote measurement requirements are assessed in terms of resolution, timeliness, repeatability, and extent of coverage. Most long term applications, such as topographic mapping and geological prospecting, are fully compatible with manned space station capabilities and would appear to warrant further development. (Author)

A71-18810 Earth orbital high data rate pulsed visible laser communications. M. Ross and J. Jackson (McDonnell Douglas Corp., St. Louis, Mo.). In: *EASCON '70; Institute of Electrical and Electronics Engineers, Electronics and Aerospace Systems Convention, Washington, D.C., October 26-28, 1970, Record*.

New York, Institute of Electrical and Electronics Engineers, Inc., 1970, p. 86-97.

Pulsed laser communication techniques have evolved that make efficient use of laser power, and take advantage of the noise statistics at optical frequencies. Studies and experiments with pulsed visible laser communication techniques have shown that highly attractive system configurations for space communications can be attained. In this paper, we present analytical and laboratory link experimental results at data rates up to 200 Mbps, and discuss the system aspects of implementing these results for Earth orbital missions, such as scientific and Earth resources applications. (Author)

A71-18827 * Integrated electro-optical systems for earth-oriented, environmental, and domestic applications. Frank E. Hoge (NASA, Wallops Station, Wallops Island, Va.). In: *EASCON '70; Institute of Electrical and Electronics Engineers, Electronics and Aerospace Systems Convention, Washington, D.C., October 26-28, 1970, Record*. New York, Institute of Electrical and Electronics Engineers, Inc., 1970, p. 295-301. 33 refs.

Recent applications of separate, single frequency microwave radar and laser (lidar) systems to various earth-oriented, environ-

mental, and domestic areas are briefly surveyed. The advantages of the integration of a separate radar and lidar into a single radar/lidar system are discussed from the vantage point of collocated electro-optical systems. Attention is focused on the design of a hybrid or integrated radar/lidar system and its potential applications in such areas as geodesy, meteorology, oceanography, navigation, and communication. In comparison with separate systems, the radar/lidar configuration is shown to be economical to manufacture, operate and maintain. The economic attractiveness is further enhanced by the worldwide availability of numerous tracking radars. Other applications of radar and optical systems in earth survey, air pollution detection, monitoring and control, and air traffic control are proposed in addition to further study efforts into the utilization of airborne and ground-based coherent radar systems. (Author)

A71-21171 # A strapdown solid-state compass. W. A. Shapiro (Bendix Corp., Navigation and Control Div., Teterboro, N.J.). *Bendix Technical Journal*, vol. 3, Winter 1970, p. 57-59.

The principles of operation of the military version of the magnetometer are examined. This instrument utilizes the saturation of a magnetic material to sense field strength. The devices used in current aircraft have a three-coil configuration. Approaches for magnetometer mounting designed to maintain proper coil orientation are discussed. It is pointed out that the ideal compass would be a strapdown device. A nonplanar coil arrangement is described and its principles of operation are considered. The magnetometer described presents none of the difficulties that are inherent in other mountings. G.R.

A71-21243 Mapping cameras in the EROS Program. Alden P. Colvocoresses (U.S. Geological Survey, Topographic Div., McLean, Va.). In: American Society of Photogrammetry and American Congress on Surveying and Mapping, Technical Conference, Denver, Colo., October 7-10, 1970, Proceedings. Falls Church, Va., American Society of Photogrammetry, 1970, p. 64-73. 7 refs.

Wide-angle film-return frame cameras, such as are common to aircraft use, have been defined for space use in both 6-inch and 12-inch focal lengths. Narrow-angle cameras producing a near-orthographic telemetered image are also considered important for planimetric mapping, map revision, and thematic mapping. A third mapping system involves telemetered telescopic images of the area obtained from two widely separated satellites in geostationary or geosynchronous orbit. All three systems are considered potentially important to the mapping of the earth and its resources. (Author)

A71-21245 A regional resource survey using small scale aerial and space photography. William C. Draeger and Lawrence R. Pettinger (California, University, Berkeley, Calif.). In: American Society of Photogrammetry and American Congress on Surveying and Mapping, Technical Conference, Denver, Colo., October 7-10, 1970, Proceedings. Falls Church, Va., American Society of Photogrammetry, 1970, p. 128-145.

During the past two years, the Phoenix, Arizona area has been the focus of research activities designed to determine the usefulness of photography obtained both from high altitude aircraft and spacecraft for making operational surveys of various earth resources on a regional basis. Emphasis has been placed on investigating the feasibility of satisfying specific data requirements of those individuals and agencies directly responsible for land use allocation or planning within the test site. In particular, the development of image specifications and data interpretation techniques for conducting regional agricultural inventories are discussed. (Author)

A71-23215 Comparative contribution of three remote sensors to geologic mapping. Richard F. Pascucci (Raytheon Co., Alexandria, Va.). In: American Society of Photogrammetry, Annual Meeting, 37th, Washington, D.C., March 7-12, 1971, Technical Papers. Falls Church, Va., American Society of Photogrammetry, 1971, p. 219-225.

It was the purpose of this investigation to interpret remote sensor data acquired over two California test sites. The sensors employed were a side-looking radar (SLR), a thermal infrared scanner (TIR), and two passive microwave radiometers. The sensor data were analyzed to determine the unique contributions that each can make to exploration geology. The principal findings of the study were: (1) SLR was the most useful of the sensors in detecting data of geologic significance; (2) TIR, however, can detect some structures and lithologies that SLR cannot; and (3) the passive microwave radiometer detected no unambiguous geologic information. (Author)

A71-23869 Observation of an emission feature at 11.7 per cm. J. G. Beery (Hawaii, University, Honolulu, Hawaii; California, University, Los Alamos, N. Mex.), T. Z. Martin, I. G. Nolt, and C. W. Wood (Hawaii, University, Honolulu, Hawaii). *Nature Physical Science*, vol. 230, Mar. 8, 1971, p. 36, 37. 10 refs. AEC-Navy-supported research.

High-resolution ground-based measurement of the spectral region ranging from 8 to 15 per cm in order to detect isotropic emission features. Interferograms of the sky were obtained at airmasses of 1.15, 2.0, 3.0, and 4.0, and the resultant spectra were examined for emission features that could not be explained by water or oxygen. A feature at about 11.7 per cm was detected which is suggested to be of atmospheric origin. Z.W.

A71-24400 Twilight airglow measurements of the OH and O₂ bands by means of balloon-borne instruments. D. R. Pick, E. J. Llewellyn, and A. Vallance Jones (Saskatchewan, University, Saskatoon, Saskatchewan, Canada). *Canadian Journal of Physics*, vol. 49, Apr. 1, 1971, p. 897-905. 17 refs. Research supported by the National Research Council of Canada.

Results of an experiment in which a gondola carrying a grating spectrometer for the 1 to 2-micron region and filter photometers with passbands at 1.27 and 1.66 micron was flown from Fort Churchill. The equipment was maintained at a height of 42 km through evening and morning twilights. The variation of the O₂ IR atmospheric band at 1.27 micron was measured for morning and evening high-latitude summer twilight. The evening decay was faster than predicted theoretically. An experimental value of 80 plus or minus 15 obtained for the intensity ratio between the 0,0 and 0,1 IR atmospheric bands. A measurement of the morning and evening twilight variation of the 5,3 OH band was obtained. (Author)

A71-26351 # Problems of laser spectroscopy (Problemy lazernoi spektroskopii). V. S. Letokhov and S. L. Mandel'shtam. *Akademiia Nauk SSSR, Vestnik*, vol. 40, Mar. 1971, p. 40-47. In Russian.

The current state of Soviet laser spectroscopy is reviewed, visualizing chemical analysis of microsamples, superhigh-resolution and excited-state spectroscopy, and laser devices with nonlinear optics (laser monochromators) as laser applications of the immediate future. The optical system of an interferometric laser seismometer, a laser air pollution analyzer and a variable-frequency dye laser are noted as examples of present laser applications in spectroscopy. V.Z.

A71-26530 # Resource assessment with the aid of space photography. Robert N. Colwell (California, University, Berkeley, Calif.). In: Engineering for the space environment; American Society of Civil Engineers and American Institute of Aeronautics and Astronautics, Specialty Conference, Houston, Tex., April 15-17, 1970, Proceedings. New York, American Society of Civil Engineers, 1970, p. 45-62. 34 refs.

Multiband, multirate, and multistage space photography information advantages over one wavelength band, one date, and one flight altitude. The information obtained can be further improved when multipurpose and multiresource studies will be made with this photography, and still further increased when several image analysts, each from a separate discipline, use the 'conference system' to engage in multianalysis. Z.W.

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A71-26532 # Ground truth - Its role in resource assessment from space. Donald T. Lauer and Don L. Olson (Lockheed Electronics Co., Houston, Tex.). In: Engineering for the space environment; American Society of Civil Engineers and American Institute of Aeronautics and Astronautics, Specialty Conference, Houston, Tex., April 15-17, 1970, Proceedings. New York, American Society of Civil Engineers, 1970, p. 93-108. 12 refs.

A determination of the true significance of remote sensor data obtained from orbiting spacecraft is heavily dependent upon the availability of authentic, reliable, representative, timely and usable ground truth information. This paper emphasizes the importance of ground measurements in remote sensing surveys. Examples are given of field measurement techniques that aid in the calibration of both the sensor imagery and the unknown terrestrial environment.

(Author)

A71-27099 # Role of water vapor dimers in radiometric investigations of the atmosphere from satellites at centimeter and millimeter wavelengths (O roli dimerov vodianogo para pri radio-metricheskikh issledovaniakh atmosfery so sputnikov v santimetrovom i millimetrovom diapazonakh voln). V. V. Demin, S. A. Zhevakin, and A. P. Naumov (Akademiia Nauk SSSR, Institut Fiziki Atmosfery, Moscow; Gor'kovskii Gosudarstvennyi Universitet, Gorki, USSR). *Akademiia Nauk SSSR, Izvestiia, Fizika Atmosfery i Okeana*, vol. 7, Feb. 1971, p. 145-150. 20 refs. In Russian.

The influence of water-vapor dimeric molecules and of inaccuracies of the description of the absorption of thermal radiation by monomeric water molecules on the interpretation of radiometric observations of the earth's atmosphere from satellites above ocean areas. It is shown that the influence of these factors on the atmospheric brightness temperature can be substantial in the atmospheric transmittance windows at millimeter wavelengths, but have a negligible effect on data interpretation at the 1.35 cm wavelength.

V.P.

A71-27255 International Society of Photogrammetry, American Society of Photogrammetry, and Ohio State University, International Symposium on Photography and Navigation, Columbus, Ohio, May 25-28, 1970, Proceedings. Edited by S. K. Ghosh (Ohio State University, Columbus, Ohio). Columbus, Ohio State University, 1971. 418 p. \$5.00.

Review of aerial photography requirements, improved aerial mapping efficiency through the use of precision inertial navigation, and the shape of the surface of the photographic materials on the triacetate and polyester base. Also considered are such subjects as practical vertical reference in verticality sensing from photographic aircraft, photographic systems for Apollo, color photography, effects of date of photography on aerial photograph interpretation, remote sensing by aerial color photography for water depth penetration, and multispectral color space photography. Airborne remote sensing techniques for oceanographic data acquisition, the interpretation of imagery colors by a television scanning system, and ecological surveillance through remote sensing are investigated together with modulation transfer functions, mensuration of holograms, and questions of calibration.

G.R.

A71-27258 * Effects of date of photography on airphoto interpretation using color and color-infrared films. Ralph W. Kiefer (Wisconsin, University, Madison, Wis.). In: International Society of Photogrammetry, American Society of Photogrammetry, and Ohio State University, International Symposium on Photography and Navigation, Columbus, Ohio, May 25-28, 1970, Proceedings.

Edited by S. K. Ghosh. Columbus, Ohio State University, 1971, p. 100-117. 13 refs. NASA-supported research.

More than 3000 exposures of color and color-infrared film on 35 mm format were taken of selected sites in Southern Wisconsin during 1969 from elevations of 2000 to 8000 feet above terrain. The subject matter includes rural terrain (cropland, grazing land, and

woodland), lakes (showing weed and algae growth), and river flood plains (showing river flooding and subsequent crop damage). Certain intensive study sites were photographed on 20 different dates during the year. The striking changes in week-to-week at the intensive study sites are illustrated in this paper. Relevant ground-truth data of selected sites are included. The results of this research show that there are certain optimum dates during the year for the procurement of aerial photography for interpretive uses. The results also show that the optimum data of photography may not be the same for different interpretive uses.

(Author)

A71-27259 Multispectral color space photography. Edward Yost and Sondra Wenderoth (Long Island University, Greenvale, N.Y.). In: International Society of Photogrammetry, American Society of Photogrammetry, and Ohio State University, International Symposium on Photography and Navigation, Columbus, Ohio, May 25-28, 1970, Proceedings.

Edited by S. K. Ghosh. Columbus, Ohio State University, 1971, p. 133-158; Discussion, p. 147. 12 refs.

The results of the NASA Apollo 9 S065 multispectral photographic experiment and supporting underflight photography will be presented. A comparison of the capability to establish basic land use patterns using multispectral additive color photos as well as color and color infrared photos - nominally sensitive to the same wave lengths of radiation - has been quantitatively performed. New techniques for making constant brightness color photographs will be presented using examples of S065 underflight photography.

(Author)

A71-28270 # Quartz magnetometer for measuring declination and the horizontal component. V. N. Bobrov (Akademiia Nauk SSSR, Institut Zemnogo Magnetizma, Ionosfery i Rasprostraneniia Radiovoln, Krasnaya Pakhra, USSR). (*Geomagnetizm i Aeronomiia*, vol. 10, no. 5, 1970, p. 945, 946.) *Geomagnetism and Aeronomy*, vol. 10, no. 5, 1970, p. 751, 752. Translation.

Discussion of the design and principles of operation of a quartz magnetometer which will measure simultaneously the magnetic declination and the horizontal component of the geomagnetic field. The quartz system incorporates a magnetosensitive element which uses a permanent magnet and a quartz mirror as the suspension system, a tiltmeter whose suspension system consists of a quartz mirror and a quartz rod which serves as a horizontal pendulum, and a fixed quartz mirror and two supplementary magnets which compensate for a substantial portion of the horizontal component in declination measurements. The device is particularly useful for magnetic surveys in the arctic and antarctic regions.

V.P.

A71-28782 Characteristic signatures of the midlatitude ionosphere observed with a narrow-beam HF backscatter sounder. Robert D. Hunsucker (ESSA, Institute for Telecommunication, Boulder, Colo.). *Radio Science*, vol. 6, May 1971, p. 535-548. 36 refs. ESSA-DOD-supported research.

Over 18,000 frames of data acquired with a narrow-beam azimuth and elevation scan high-frequency backscatter sounder located at Boulder, Colorado, during the period October 1964 through June 1968 have been examined and classified. Analysis of these data has revealed that the 'irregular structure' of the midlatitude ionosphere is the rule rather than the exception. Irregularities of varying scale size and apparent motion were present in about 90% of the observations made during almost one-half a sunspot cycle. The 'signatures' observed by this HF radar system have been categorized into eight generic types, which have been labeled with names roughly describing their appearance on the range-azimuth scan record. The relative diurnal and seasonal occurrences, as well as the qualitative sunspot cycle and geomagnetic correlation of these signatures, are presented.

(Author)

A71-30126 # Airborne measurements of earth surface temperature (ocean and land) in the 10-12- and 8-14-micron regions. M. Weiss (Barnes Engineering Co., Stamford, Conn.). *Applied Optics*, vol. 10, June 1971, p. 1280-1287. 5 refs. Contract No. N00014-68-C-0307.

Field experience using infrared radiometers for making airborne measurements of land and ocean surface temperature shows that an atmospheric induced error and a surface reflectivity error are present when the 8-14-micron atmospheric window is used. It is generally accepted that the error can be minimized by working in a narrow region of the atmospheric window centered at about 10.5 microns. In order to evaluate the improvement in performance using the narrow band filter region, simultaneous airborne measurements were made with two Barnes model PRT-5 infrared radiometers flown side by side over land and water areas for a range of altitudes up to 8000 ft. One radiometer contained an 8-14-micron (standard) filter, and the second contained a 10-12-micron filter. Comparison of the data shows the narrow band filter to reduce the measured error 1.5-2.0 times compared with the wide band filter. The data also show that the error increases approximately linearly with altitude, and therefore by taking measurement at two altitudes and linearly extrapolating to ground level, an accuracy of measurement of a few tenths of a degree Celsius is possible. (Author)

A71-30497 Atmospheric optics and radiative transfer. John N. Howard and John S. Garing (USAF, Cambridge Research Laboratories, Bedford, Mass.). *EOS*, vol. 52, June 1971, p. IUGG 371-IUGG 389. 718 refs.

Survey of studies conducted since 1967 on the insolation of the atmosphere, the earth's albedo, sky brightness, cloud and terrain reflectance, and atmospheric heat balance. Progress in determining the spectroscopic constants of individual atmospheric molecules is cited, together with developments in research on single and multiple scattering on water droplets, polydisperse aerosols, and haze. Important works are surveyed in areas of atmospheric laser propagation, radiative transfer, satellite observations, remote sensing techniques, and atmospheric pollutants. T.M.

A71-30498 Meteorological satellite program. S. Fritz, L. F. Hubert, E. P. McClain, W. L. Smith, and J. S. Winston (NOAA, Suitland, Md.). *EOS*, vol. 52, June 1971, p. IUGG 405-IUGG 410. 100 refs.

The instrumentation and orbital parameters of U.S. meteorological satellites launched since 1967 are described, and meteorological research based on satellite data from this period is surveyed. Satellite activities contributed to developments in synoptic meteorology by providing extensive data on winds, tropical circulations, and extra-tropical circulations. Conclusions gained by analysis of vertical soundings are listed, along with progress in problems concerning the heat budget of the earth-atmosphere system, general circulation dynamics, hydrology, and ocean surface parameters. T.M.

A71-30896 NTC '71; Institute of Electrical and Electronics Engineers, National Telemetering Conference, Washington, D.C., April 12-15, 1971, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1971. 346 p. Members, \$17.50; nonmembers, \$20.

Theoretical and experimental research on transmission codes, data processing techniques, sensors, transmitters, receivers, and system design procedures for telemetry applications in medicine, industry, law enforcement, transportation, earth resources, and environmental monitoring. Detailed descriptions are given of systems used for satellite data collection, seismic data acquisition, weather observations, petroleum surveys, air traffic control, urban traffic measurement, image processing, emergency medical communications, and biological observations. FM threshold extension, random multiple access, asynchronous TDM, and color TV transmission systems are outlined. Some studies are directly concerned with increasing the efficiency of electromagnetic spectrum utilization in areas of high message traffic density.

A71-30901 Wideband image recorder for the Earth Resources Technology Satellite. J. M. Hayes (NASA, Goddard Space Flight Center, Systems Engineering Branch, Greenbelt, Md.) and F.

D. Kell (RCA, Communications Systems Div., Camden, N.J.). In: NTC '71; Institute of Electrical and Electronics Engineers, National Telemetering Conference, Washington, D.C., April 12-15, 1971, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 46-53. Contract No. NAS 5-11643.

Description of the Video Tape Recorder (VTR) which provides on-board storage capability for both wideband analog (4 MHz) and high rate digital (15 megabits/sec) sensor outputs. A storage capacity of over 30 min has been demonstrated. The use of VTR on ERTS will permit 100% worldwide coverage if desired, and experimental tests have indicated that the VTR operational life is more than adequate for the anticipated operation on the one-year ERTS A and ERTS B missions. F.R.L.

A71-30908 A random multiple access technique for satellite data collection. Albert E. Arndt (NASA, Goddard Space Flight Center, Greenbelt, Md.), Robert C. Sommer, and Forrest H. Stieg (Computer Sciences Corp., Falls Church, Va.). In: NTC '71; Institute of Electrical and Electronics Engineers, National Telemetering Conference, Washington, D.C., April 12-15, 1971, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 100-108.

Description of a random multiple access technique by which, under the control of self-contained oscillators, each platform transmits its message on a carrier frequency which is not highly stabilized, at times which are not precisely periodic. Advantage is taken of the inherent frequency instability associated with unsophisticated oscillator circuits, fabricated with low precision components, to provide the desired randomness among the platform transmissions. One application to which random multiple access is ideally suited is the data collection system of the Earth Resources Technology Satellite (ERTS). F.R.L.

A71-30938 # Temperature soundings by means of radiometric measurements from satellites (Sondaggi di temperatura mediante misure radiometriche da satelliti). B. Bizzarri. *Rivista di Meteorologia Aeronautica*, vol. 31, Apr.-June 1971, p. 169-176. 7 refs. In Italian.

Discussion of the problem of the treatment of temperature data measured by means of the new satellite spectrometers currently being tested. The mathematical process of inversion of radiometric measurements from satellites in order to obtain the vertical temperature profile is described for the purpose of giving an idea of the complexity of processing the data to be obtained from second-generation meteorological satellites. M.M.

A71-31409 Optically pumped magnetometers (Absorptionszellen-Magnetometer). L. Engelhard (Braunschweig, Technische Universität, Braunschweig, West Germany). *Zeitschrift für Geophysik*, vol. 37, May 1971, p. 1-37. 132 refs. In German.

Optically pumped magnetometers are shown to be suitable for measurements of the earth's and interplanetary magnetic field. The method of measurement is based on the Zeeman effect of free atoms. In order to utilize this effect, the free atoms must be optically pumped. The different possibilities of determining the resonant frequency and the specific properties of the various gases used in magnetic field measurements are discussed in detail. A short summary of the phenomenological theory of the resonance in optically pumped gases is given and possibilities of measurement of the magnetic field vector components are examined. O.H.

A71-31459 # Manning an earth-resources survey system in orbit. Thomas L. Fischetti (NASA, Washington, D.C.), Don L. Lind, and O. Glenn Smith (NASA, Manned Spacecraft Center, Houston, Tex.). *Astronautics and Aeronautics*, vol. 9, June 1971, p. 58-65. 5 refs.

Detailed profile of the Earth Resources Experiment Package (EREP) and its constituents and operations. Components of EREP include five sensors: a multispectral photographic facility; an infrared

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spectrometer; a multispectral scanner; a microwave radiometer/scatterometer and altimeter; and an L-band radiometer. Their functions and the tasks of the crew in operating them are described. It is considered that the future principal utility of a man in space will be as a scientific observer. F.R.L.

A71-31835 Infrared photographs of the earth from satellites and the possibility of their interpretation (Infrarotaufnahmen der Erde von Satelliten und ihre Aussagemöglichkeit). Heinz Kaminski (Bochum, Sternwarte, Bochum, West Germany). *Naturwissenschaftliche Rundschau*, vol. 24, June 1971, p. 244-252. 12 refs. In German.

The underlying principles of infrared photography and camera systems for satellite infrared photography are briefly explained. It is shown that this technique can be utilized for a wide range of advanced studies such as in glaciology and hydrology, oceanography, geology, volcanology, for environmental protection, etc. Several practical examples are presented. O.H.

A71-32295 Nimbus weather satellites - Remote sounding of the atmosphere. Gerald L. Wick. *Science*, vol. 172, June 18, 1971, p. 1222, 1223.

Description of the operational features of various instruments on board the Nimbus 3 and Nimbus 4 weather satellites. A satellite infrared spectrometer and a Michelson infrared interferometer spectrometer are described, as well as a British-built detector called a selective chopping radiometer. All of these instruments supply data concerning the atmospheric temperature from radiometric measurements of infrared emission due to transitions between vibrational levels of carbon dioxide molecules. The problem of obtaining accurate measurements of radiation emitted by the earth's surface in the presence of cloud cover is considered. A.B.K.

A71-33582 Technological requirements for applications of remote sensing satellite systems to earth resources missions. G. W. Morgenthaler (Martin Marietta Corp., Denver, Colo.). In: *Organizing space activities for world needs; International Academy of Astronautics, International Astronautical Congress, 19th, New York, N.Y., October 13-19, 1968, Proceedings*. Edited by E. A. Steinhoff. Oxford, Pergamon Press, Ltd., 1971, p. 125-155. 26 refs. NOAA-PHS-sponsored research.

The aim of the discussion is to identify gaps or deficiencies in the present systems and technology areas that prevent immediate institution of effective Earth Resources Remote Sensing Systems (ERSS). It is found that there exist problems related to improved sensor development, establishment of truth sites, satellite improvements, cataloging of signature, and understanding and controlling contamination of the optical sensors. However, steady progress is being made in these fields. Problems such as spectral and spatial recognition (interpretation), data management, and the establishment of macro models of ecological and resource relationships are extremely difficult, and will determine the rate of development of ERSS technically. G.R.

A71-33749 # Canada's approach to remote sensing. L. W. Morley (Department of Energy, Mines and Resources, Remote Sensing Centre, Ottawa, Canada). *COSPAR, Plenary Meeting, 14th, Seattle, Wash., June 18-July 2, 1971, Paper*. 28 p.

The Canadian program of remote sensing is outlined with respect to its inception, present organization, and international cooperation efforts, as well as current and future objectives. It is pointed out that Canada could not dismiss remote sensing as a luxury beyond her means because of the promise it bears of becoming an enormously powerful tool for gathering and sorting vast amounts of information in areas of as vital concern as those of resources and the environment. Hence, a concerted effort is being programmed to achieve a proper balance between spaceborne, airborne, and surface

data collection, on the one hand, and between hardware development and data interpretation, on the other. M.V.E.

A71-33967 Rocket-borne ultraviolet spectrometer measurement of OH resonance fluorescence with a diffusive transport model for mesospheric photochemistry. James G. Anderson (Colorado, University, Boulder, Colo.). *Journal of Geophysical Research*, vol. 76, July 1, 1971, p. 4634-4652. 52 refs.

An upper limit on the column density of the hydroxyl radical in the earth's upper atmosphere was determined. The (0-0) band of a transition at 3064 Å was studied between 60 and 108 km under evening twilight conditions from Wallops Island, Virginia, on June 27, 1969. The solar zenith angle was 92 deg. Particular attention is given to the problem of determining the Rayleigh scattered background to allow an accurate determination of the column emission rate from the OH molecule. An emission rate factor calculation for OH is presented. G.R.

A71-34245 * # Satellites for observation of the earth. John M. Denoyer (NASA, Office of Space Science and Applications, Washington, D.C.). *ITU Telecommunication Journal*, vol. 38, May 1971, p. 369-372.

Remote sensing from satellites as a significant tool to describe and understand environmental systems is discussed. Available remote sensing methods are briefly reviewed, and a number of areas where uses of these techniques have been developed are discussed. These areas include: crop and timber identification; detection of condition of crops and timber; soil moisture and surface water measurements; snow mapping; thermal mapping of bodies of water; measurements of upwelling in the oceans, ocean salinity, and ocean, lake, and river color; marine hazard evaluation; determination of geologic features; compilation and updating of maps; and damage assessment. Some unique characteristics of satellites that make them particularly suitable for these remote sensing purposes are pointed out. O.H.

A71-34801 Institute of Electrical and Electronics Engineers and Western Electronic Manufacturers Association, Western Electronic Show and Convention, Los Angeles, Calif., August 25-28, 1970, Proceedings. North Hollywood, Calif., Western Periodicals Co. (WESCON Technical Papers. Volume 14), 1970. 680 p. \$65.

Topics include millimeter systems, LSI memories, active and passive filters, medical electronics, optoelectronic devices, and component manufacturing for the 70s. The optimizing selection of vacuum deposition equipment is discussed together with low-noise amplification problems at microwave frequencies, the integrated circuit overseas, the next generation of satellite systems, instrumentation for data acquisition and control systems, advances in commercial avionics, and instrumentation guidelines for the study and control of ecology and water pollution. Management control systems and management of the development of software systems, evaluation of proprietary software, minicomputers in process industries, and the impact of interactive computing systems on engineering problem-solving are considered. A permuted index is included. G.R.

A71-34712 * # Skylab earth resources experiment package. Dallas E. Evans and Peter J. Armitage (NASA, Manned Spacecraft Center, Houston, Tex.). *American Institute of Aeronautics and Astronautics, Space Systems Meeting, Denver, Colo., July 19, 20, 1971, Paper 71-841*. 5 p. Members, \$1.50; nonmembers, \$2.00.

The selection of instruments for earth resources experiments includes those that explore the widest possible portions of the electromagnetic spectrum for pattern recognition studies in the earth survey disciplines. The earth survey disciplines are generally those of geology, geography, hydrology, agriculture, forestry, oceanography, and meteorology. The sensor techniques required to obtain the necessary pattern recognition characteristics are those of photography, infrared, passive microwave, and active microwave - namely, radar. Multisensor and, in particular, multispectral imaging sensor systems will provide the greatest information. The data from the Skylab earth resources instruments will be recorded either on

photographic film and/or magnetic tape and will be brought back by the returning crew. The Skylab 50 deg orbital inclination will provide opportunity for test sites of interest most anywhere in the United States to be investigated with remote sensing. (Author)

A71-35292 # Laser-Raman remote gas sensing. M. C. Johnson (Bendix Research Laboratories, Southfield, Mich.). *Bendix Technical Journal*, vol. 4, Spring 1971, p. 55-57, 60, 11 refs.

Incorporation of a laser to make the Raman effect a practical instrument technique for remote gas sensing. If a gas sample is irradiated with the single wavelength of the laser and the scattered radiation is examined, using a high-resolution monochromator, a very large Rayleigh peak is seen, as well as a series of much smaller peaks at other wavelengths nearby. The frequency of each peak identifies the molecule, and the intensity of each peak indicates the number of molecules being irradiated. Since most pollutant gases such as SO₂, CO, and NO have well separated Raman lines, it is considered that the Raman effect may provide a technique for the universal monitoring of stack gases if the problems of low SNR can be overcome. F.R.L.

A71-35428 # Design of specialized observation modules. R. J. Kirby (General Electric Co., Valley Forge, Pa.) and R. S. Johns (Martin Marietta Corp., Denver, Colo.). *American Institute of Aeronautics and Astronautics, Space Systems Meeting, Denver, Colo., July 19, 20, 1971, Paper 71-815*, 34 p.

Results of design studies conducted for two experiment modules, one supporting earth observations research and the other supporting stellar astronomy research. Both modules represent specialized members of a common set of general purpose modules rather than unique special-purpose modules. The Space Station experiment accommodation studies concluded that with few exceptions all of the experiment module requirements could be accommodated by a basic set of common structural elements to which unique experimental hardware is added. F.R.L.

A71-35905 # Orbital photography as applied to natural resources survey. R. A. van Zuidam. *ITC Publications, Series B*, Mar. 1971, p. 1, 3-7, 9-59, 74 refs. Research supported by the Netherlands Foundation for the Advancement of Tropical Research.

Various types of orbital imaging techniques for natural resources surveying are described, and their limitations and possible applications are evaluated. Existing literature concerning orbital image interpretation is reviewed with appropriate commentaries, and attention is given to the possibility of directly preparing geomorphological and geological reconnaissance maps of remote areas on the basis of orbital photographs. This would eliminate the conventional time-consuming procedure of reduction and generalization of detailed maps. The available imagery of northern Chad and adjacent areas was studied to satisfactorily evaluate orbital photography for this purpose. Ground truth was established by a geomorphological reconnaissance survey in October and November 1969. It is concluded that orbital photography can be useful in such matters as the discovery of very large features and structures that might otherwise escape attention because of the lack of a comprehensive image. Furthermore, numerous previously unknown phenomena of smaller size can be detected in poorly known areas. T.M.

A71-35921 # Three-component magnetometer for determining the position of the polar electrojet (Drei-Komponenten-Magnetometer für die Peilung des polaren Elektrojets). Siebert Müller. Braunschweig, Technische Universität, Institut für Geophysik und Meteorologie, Dissertation, 1970, 70 p. 12 refs. In German.

The investigations were conducted in order to obtain data regarding the location of the electrojet for a subsequent exploration of the electrojet structure by a sounding rocket. The system used consisted of two three-component magnetometers with equipment for transmitting the measured parameters to the rocket launching

site. The six probes of the magnetometer were buried in the ground to maintain them at a nearly constant temperature. The probes provide as output signal a dc voltage which is proportional to the intensity of the magnetic field. The dc signal was transformed into a 1f ac signal for transmission by the public telephone network. The constant component of the geomagnetic field was suppressed by a displacement of the zero point. G.R.

A71-36051 Photo-optical instrumentation for the 70's; Society of Photo-optical Instrumentation Engineers, Annual Technical Symposium, 15th, Anaheim, Calif., September 14-17, 1970, Proceedings. Symposium co-sponsored by the U.S. Air Force and the U.S. Army. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers (SPIE Annual Technical Symposium Proceedings, Volume 3), 1971, 544 p. Members, \$20.; nonmembers, \$26.

Subjects include electrooptical systems, coherent optics, technological forecasting in photooptical and electrooptical systems, earth resources and environmental quality, biomedical studies, fiber optics, data reduction, image enhancement and restitution, and photooptical data recording. V.Z.

A71-36065 The infrared radiance of the earth between 5 and 20 microns. C. M. Randall and R. D. Rawcliffe (Aerospace Corp., El Segundo, Calif.). In: Photo-optical instrumentation for the 70's; Society of Photo-optical Instrumentation Engineers, Annual Technical Symposium, 15th, Anaheim, Calif., September 14-17, 1970, Proceedings. Symposium co-sponsored by the U.S. Air Force and the U.S. Army. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers (SPIE Annual Technical Symposium Proceedings, Volume 3), 1971, p. 157-161. Contract No. AF 04(701)-70-C-0059.

Analysis of IR earth radiance data obtained by the InfraRed Interferometric Spectrometer (IRIS) of the Nimbus 3 satellite on its 32nd orbit on Apr. 16, 1969. The presence of clouds is found to be the dominant variable of radiance while the effects of land-to-ocean shifts in subsatellite points and those of the time of the day were insignificant. Good qualitative agreement was obtained between the IRIS radiance data and radiance data of a multichannel Medium Resolution Infrared Radiometer (MRIR) carried by the satellite. V.Z.

A71-36101 The infrared radiance of the earth between 5 and 20 microns. C. M. Randall and R. D. Rawcliffe (Aerospace Corp., El Segundo, Calif.). *SPIE Journal*, vol. 9, Apr.-May 1971, p. 118-121. Contract No. AF 04(701)-70-C-0059.

Review of some of the infrared earth radiance data obtained by means of the infrared interferometric spectrometer (IRIS) aboard the NIMBUS 3 satellite over the 5 to 25 micron band. The acquisition of these data occurred on Apr. 16, 1969, on orbit 32 (before a gradually developing mirror misalignment degraded the IRIS performance) starting south of Cuba, continuing over Asian Russia during the night, and terminating off the western coast of Mexico during the day. The shape of the spectrum is found to be roughly constant from scan to scan. However, the intensity changes significantly as clouds or earth of differing temperatures are viewed. The observed radiance does not appear to depend appreciably on whether it is day or night or on whether the instrument is viewing land or sea. The dominant variable is the presence of clouds. M.V.E.

A71-36361 * MSDS - An experimental 24-channel multi-spectral scanner system. Eugene M. Zaitzeff, Charles L. Wilson (Bendix Corp., Aerospace Systems Div., Ann Arbor, Mich.), and C. Laurence Korb (NASA, Manned Spacecraft Center, Earth Observation Div., Houston, Tex.). *IEEE Transactions on Geoscience Electronics*, vol. GE-9, July 1971, p. 114-120.

Description of a multispectral scanner which is being developed for a NASA C-130 earth-resources survey aircraft. The scanner will be capable of simultaneously viewing 24 wavelength bands in the range between 0.34 and 13 micrometers; it will have a spatial resolution of 2 mrad and an active scan of 80 deg. The spectral bands

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are formed by detector arrays in the focal plane of two grating spectrometers. All bands are radiometrically calibrated using field-filling sources that are viewed during the inactive part of the scan cycle. The scanner has been installed and test flown during the latter part of 1970, and will be delivered to NASA in the summer of 1971. M.M.

A71-36363 * **Operational calibration of an airborne infrared spectrometer over geologically significant terrains.** R. J. P. Lyon and A. A. Marshall (Stanford University, Stanford, Calif.). *IEEE Transactions on Geoscience Electronics*, vol. GE-9, July 1971, p. 131-138. 7 refs. Contract No. NAS 9-7313.

A three-instrument IR spectral emittance experiment, comprising a rapid-scan spectrometer, radiometer, and boresight camera, has been flight tested over selected geological terrain in central and southern California and Nevada. Pre- and post-flight calibrations of the IR spectrometer were performed both by using polished samples of 'standard' rocks (quartz diorite and gabbro) as well as the more familiar blackbody radiance standards. By flying over a body of water and recording the radiance spectrum of that target it is possible to determine the transmission spectrum of the atmospheric path between the aircraft and the water (at least to a first approximation) as both the spectral emittance of lake water and the optical transfer functions of the instrument are known or can be calculated. So far, flights have been made only at low altitudes, with the lake surface at 2000 or 6000 ft above sea level. M.M.

A71-36539 **Application of airborne and satellite remote sensing in earth sciences.** J. Bodechtel (München, Universität, München, West Germany). In: Space and communication: Acquisition and transmission of data in space applications systems; Union des Associations Techniques Internationales and Société Française des Electroniciens et des Radioélectriciens, International Conference, Paris, France, March 29-April 2, 1971, Communications. Volume 1 (L'espace et la communication: Collecte et transmission de l'information dans les systèmes spatiaux d'application; Union des Associations Techniques Internationales and Société Française des Electroniciens et des Radioélectriciens, Colloque International, Paris, France, March 29-April 2, 1971, Communications. Volume 1). Colloquium co-sponsored by the Fédération Nationale des Industries Electroniques and the Centre National d'Etudes Spatiales. Paris, Comité d'Organisation du Colloque de Paris, 1971, p. 529-540. 10 refs.

Survey of the possible applications of remote sensing techniques in various earth sciences. The sensor techniques, the resolution obtained, and the effect of the distance between target and sensor are briefly described. The use of different aircraft and satellite techniques in geology, soil science, geography, and hydrology is examined. Z.W.

A71-38453 **Earth resources experiments packages electromagnetic compatibility with AAP.** R. W. Ellison (Martin Marietta Corp., Denver, Colo.). In: The expanding science of EMC; Institute of Electrical and Electronics Engineers, International Symposium on Electromagnetic Compatibility, Anaheim, Calif., July 14-16, 1970, Symposium Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1970, p. 356-364. 38 refs.

Integration of a package of earth resources experiments is dependent on sufficient EM compatibility data to assure compatibility with the manned spacecraft, its support equipment, and its complement of science, technology, engineering, and medical experiments. The dominant interference on sizable spacecraft is transient in nature - switching transients, inverter transients, and regulator transients. The early compilation of EM compatibility data on conducted transients, on plasma sheath effects, and on contamination levels will enhance the ability to attain maximum useful data from space-based experimental packages. G.R.

A71-39612 **Space research XI; COSPAR, Plenary Meeting, 13th, and Symposium on Remote Sounding of the Atmosphere,**

Leningrad, USSR, May 20-29, 1970, Proceedings. Volumes 1 & 2. Meeting and Symposium co-sponsored by the International Union of Geodesy and Geophysics and the World Meteorological Organization. Edited by K. Ia. Kondrat'ev, M. J. Rycroft, and C. Sagan. Berlin, East Germany, Akademie-Verlag, 1971. Vol. 1, 719 p.; vol. 2, 627 p. Price of two volumes, \$31.

The papers deal with physical sciences and space research concerning the moon, planets, cosmic dust, dry land physics, remote sounding of the atmosphere, the neutral atmosphere, the ionosphere, solar terrestrial relations, and astronomical measurements. V.P.

A71-39673 # **Investigations from aircraft for sounding the atmosphere by means of microwave radiation.** K. S. Shifrin, Iu. I. Rabinovich, and G. G. Shchukin. In: Space research XI; COSPAR, Plenary Meeting, 13th, and Symposium on Remote Sounding of the Atmosphere, Leningrad, USSR, May 20-29, 1970, Proceedings. Volume 1. Meeting and Symposium co-sponsored by the International Union of Geodesy and Geophysics and the World Meteorological Organization. Edited by K. Ia. Kondrat'ev, M. J. Rycroft, and C. Sagan. Berlin, East Germany, Akademie-Verlag, 1971, p. 601-607. 13 refs.

The physical principles of a microwave method for sounding the atmosphere and underlying surface are discussed and a comparison made of this method with the infrared method. Theoretical investigations of microwave radiation transfer in the atmosphere include the determination of optical characteristics according to Mie theory. The field of microwave radiation of the system (surface, precipitation layer, cloud layer, clear atmosphere) is calculated by the equation of transfer. Aircraft measurements are presented, including: total water vapor content in the vertical column of the atmosphere; cloudiness and precipitation zones; temperature of the underlying surface; characteristics of ice cover; and an analysis is made of their accuracy. The range of values and accuracy of measurement of each characteristic is indicated. (Author)

A71-39675 # **Spectrophotometry of the earth from manned spacecraft.** K. Ia. Kondrat'ev, A. A. Buznikov, B. V. Vinogradov, V. N. Volkov, V. V. Gorbato, and O. I. Smokty (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR). In: Space research XI; COSPAR, Plenary Meeting, 13th, and Symposium on Remote Sounding of the Atmosphere, Leningrad, USSR, May 20-29, 1970, Proceedings. Volume 1. Meeting and Symposium co-sponsored by the International Union of Geodesy and Geophysics and the World Meteorological Organization. Edited by K. Ia. Kondrat'ev, M. J. Rycroft, and C. Sagan. Berlin, East Germany, Akademie-Verlag, 1971, p. 619-632. 6 refs.

Discussion of the results of spectrophotometric and photographic observations of the twilight aureole of the earth, the clouds, and the underlying surface from the manned Soyuz 5 and Soyuz 7 spacecraft. Spectra of the twilight aureole, such as first obtained from space observations, made it possible to determine the vertical profiles of aureole brightness for various wavelengths in absolute units. Comparison of the measured aureole brightness with calculated data permitted the derivation of information on the vertical brightness profiles in the twilight region. Analyses of cloudiness spectra and those of underlying surfaces simultaneously recorded from spacecraft and aircraft made possible estimates of the observed brightness variations of natural formations and assessments of the influence of atmospheric haze on the values of brightness and spectral contrast. M.V.E.

A71-39684 * # **Possible measurements of surface characteristics with remote sensors.** K. J. K. Buettner (Washington, University, Seattle, Wash.). In: Space research XI; COSPAR, Plenary Meeting, 13th, and Symposium on Remote Sounding of the Atmosphere, Leningrad, USSR, May 20-29, 1970, Proceedings. Volume 1. Meeting and Symposium co-sponsored by the International Union of Geodesy and Geophysics and the World Meteorological Organization. Edited by K. Ia. Kondrat'ev, M. J.

Rycoft, and C. Sagan. Berlin, East Germany, Akademie-Verlag, 1971, p. 705-712. 21 refs. Grant No. NSG-632.

Review of surface characteristics which are amenable to or connected with remote sensing, and are of potential value to the meteorologist, with emphasis on new proposals. Over-land albedo measurements at 0.7, 1.1, and 1.5 micrometer are proposed. This triple system would tell about ground type (clouds, vegetation, sand or soil, and snow). Clouds could be discerned from snow, and fresh snow from wet snow. F.R.L.

A71-40039 Requirements for rocket auroral spectroscopy in the vacuum ultraviolet. J. R. Catchpoole (York University, Toronto, Canada). *Journal of Atmospheric and Terrestrial Physics*, vol. 33, Sept. 1971, p. 1329-1336. 8 refs.

Detection of the features of the auroral UV spectrum and the measurement of their relative intensities are of diagnostic importance to the theory of physical processes in the upper atmosphere. With specific reference to preparations for rocket spectroscopic observations on the aurora, this paper reports some relevant preliminary calculations dealing especially with the likely effects of atmospheric absorption on the overall instrumental sensitivity. Probable effective viewing times and required auroral intensities are discussed. (Author)

A71-40977 # Laser remote sensing of atmospheric refractive index fluctuation profile. M. Subramanian (Bell Telephone Laboratories, Inc., Whippany, N.J.). *Optical Society of America, Spring Meeting, Tucson, Ariz., Apr. 5-8, 1971, Paper. 26 p.* 11 refs.

Using a laser remote sensing technique, the fluctuation profile of the refractive index of the troposphere has been measured at Chester, New Jersey. The measurements have been made with a ground based optical tracker which tracks a retroreflector mounted on a tethered balloon. The balloon is flown and the intensity scintillation on the return beam is measured for several altitudes. From the scintillation data obtained, the structure constant, which is a measure of the strength of turbulence, is estimated as a function of altitude. The measurements were made during day time in the winter of 1969 and summer of 1970. The average refractive index fluctuation profiles for the winter and summer months are presented; they show the turbulence close to the ground in summer months to be higher than that in winter months, by approximately a factor of three. (Author)

A71-41629 Mapping the atmosphere from space. Robert Harwood (Oxford University, Oxford, England). *New Scientist and Science Journal*, vol. 51, Sept. 16, 1971, p. 622-624.

A British experimental instrument called Selective Chopper Radiometer (SCR) is at present flying on board the Nimbus 4 satellite launched by NASA. The instrument yields information about the atmospheric temperature profile. As the satellite moves in orbit, a three-dimensional map of global temperature can be constructed. These maps give important clues to the atmospheric circulation and energy exchange, which will aid long range weather predictions. SCR measures the amount of IR radiation by carbon dioxide in the atmosphere within six carefully selected wavelength regions. G.R.

A71-41654 # The role of water-vapor dimers in satellite radiometric studies of the atmosphere at centimeter and millimeter wavelengths. V. V. Demin, S. A. Zhevakin, and A. P. Naumov (Akademiia Nauk SSSR, Institut Fiziki Atmosfery, Moscow; Gor'kovskii Gosudarstvennyi Universitet, Gorki, USSR). (*Akademiia Nauk SSSR, Izvestiia, Fizika Atmosfery i Okeana*, vol. 7, Feb. 1971, p. 145-150.) *Academy of Sciences, USSR, Izvestiya, Atmospheric and Oceanic Physics*, vol. 7, Feb. 1971, p. 100-103. 20 refs. Translation.

The influence of water-vapor dimeric molecules and of inaccuracies of the description of the absorption of thermal radiation by monomeric water molecules on the interpretation of radiometric observations of the earth's atmosphere from satellites above ocean areas. It is shown that the influence of these factors on the

atmospheric brightness temperature can be substantial in the atmospheric transmittance windows at millimeter wavelengths, but have a negligible effect on data interpretation at the 1.35 cm wavelength. V.P.

A71-41967 # Remote sensing techniques in evaluating earth resources - Study of potential uses of ERTS for southeastern U.S. Firouz Shahrokhi and J. P. Rhudy (Tennessee, University, Tullahoma, Tenn.). *International Astronautical Federation, International Astronautical Congress, 22nd, Brussels, Belgium, Sept. 20-25, 1971, Paper. 28 p.*

Details are given on remote sensing techniques as an effective source of earth resources data from ERTS missions. Specific requirements of these techniques when applied to the southeastern portion of the United States are discussed. Land use, agriculture, forestry, strip mine land reclamation, thermal pollution from electric power plants, and stream pollution by industrial waste dumping are covered as major objectives of ERTS missions in that region. Interpretation of data performed on several high-altitude color IR pictures and Apollo multispectral photographs is described. It is concluded that resource management can be made more effective by using advanced remote sensing techniques to improve information accessibility. V.Z.

A71-42410 # Nimbus 3 'SIRS' pressure height profiles as compared to radiosondes. C. M. Hayden (NOAA, National Environmental Satellite Service, Washington, D.C.). *Monthly Weather Review*, vol. 99, Sept. 1971, p. 659-664.

Tropospheric height and thickness values derived from Nimbus 3 Satellite Infra-Red Spectrometer (SIRS) sounding data are compared with nearby radiosonde data to determine (1) the accuracy and compatibility of SIRS data relative to the radiosonde and (2) the utility of SIRS data relative to the radiosonde, for objective analysis. The study shows that both the relative accuracy and the utility of the SIRS data are strongly dependent on cloud conditions, pressure level, and instrument status. SIRS thickness values in the upper troposphere compare well with radiosonde data. Loss of the 714 per cm channel in November 1969 greatly reduced the quality of the SIRS data, especially at lower levels; but prior to the loss, clear-air soundings show approximate parity with radiosonde observations. (Author)

A71-42425 Infra-red linescan - The technique and its application. P. J. Griffiths (Hawker Siddeley Dynamics, Ltd., Hatfield, Herts., England). *Institution of Electronic and Radio Engineers, Joint Conference on Infra-Red Techniques, University of Reading, Reading, Berks., England, Sept. 21-23, 1971, Paper. 8 p.*

The paper describes the general concepts and features of current infrared linescan systems. It outlines the factors influencing the choice of infrared waveband and proceeds to define the primary system parameters, their interrelation, limitations and effect on system design. Picture display techniques are discussed with emphasis on film recording. The paper ends by illustrating some detection and survey applications for which linescan offers potential advantages over conventional equipment. (Author)

A71-44984 * Airborne measurements of reflected solar radiation. Vincent V. Salomonson (NASA, Goddard Space Flight Center, Greenbelt, Md.) and William E. Marlatt (Colorado State University, Fort Collins, Colo.). *Remote Sensing of Environment*, vol. 2, Oct. 1971, p. 1-8. 20 refs. Contract No. NASr-147.

Measurement of the directional variation in reflected solar radiation over soils and vegetation using an aircraftborne scanning radiometer with a field of view of 50 mrad. Bidirectional reflectances were observed in two portions of the solar spectrum (0.2 to 4.0 microns and 0.55 to 0.85 micron) at times when the solar zenith angle was between 55 and 80 deg. Flights were made over a dry desert lake bed devoid of vegetation, a soil surface covered by short grasses, and a densely vegetated surface. The results show anisotropy in the reflected solar radiation over each of the surfaces. The largest bidirectional reflectances were observed in the backscattering direc-

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tions (at angles greater than 90 deg to the direction of the incident radiation). Over the dry desert lake bed, higher bidirectional reflectances were observed in the 0.55 to 0.85 micron bandpass than in the 0.2 to 4.0 microns bandpass; however, over the densely vegetated surface the larger reflectances were observed in the 0.2 to 4.0 microns bandpass. The overall results support suggestions that crop identification and radiation budget determinations are possible over large agricultural areas through appropriate spectroradiometric measurements from satellites. (Author)

A72-10363 Results of observation of the thermal radio emission of the earth's surface in an experiment on the Cosmos-243 satellite. A. E. Basharinov, A. S. Gurvich, S. T. Egorov, V. I. Zhukov, A. A. Kurskaia, L. I. Malafeev, D. T. Matveev, A. S. Mikhailov, and A. M. Shutko. (*Kosmicheskie Issledovaniia*, vol. 9, Mar.-Apr. 1971, p. 268-279.) *Cosmic Research*, vol. 9, Oct. 1971, p. 247-256. 15 refs. Translation.

Satellite measurements of the earth's thermal radiation are analyzed, showing that uhf radiometry data make it possible to determine the temperature conditions, water areas, ice fields, and various land areas. Radio brightness profiles of water areas and typical mountainous, desert, and ice-covered areas are presented and discussed. V.P.

A72-10448 American Society of Photogrammetry, Fall Convention, Symposium on Computational Photogrammetry, San Francisco, Calif., September 7-11, 1971, Proceedings. Convention co-sponsored by the American Congress on Surveying and Mapping. Falls Church, Va., American Society of Photogrammetry, 1971. 781 p. Members, \$2.50; nonmembers, \$5.00.

Remote-sensing imagery systems for use in photogrammetry are examined in terms of camera details, film types, data transmission operations, recording procedures, display devices, interpretation techniques, and mapping methods. Radar imagery, multispectral black and white photography, color photography, and color infrared photography are evaluated for earth resource surveys and for crop and vegetation studies. Terrain classification, urban research, and water-body observations (drainage and currents) are also considered. Systems design data, error analyses, and calibration procedures are examined in detail for aerial triangulation systems.

T.M.

A72-10530 # Interpretation problems in the correlation-mask sensing technique. C. R. McCreight and C. L. Tien (California, University, Berkeley, Calif.). *ACS, AIAA, EPA, IEEE, ISA, NASA, and NOAA, Joint Conference on Sensing of Environmental Pollutants, Palo Alto, Calif., Nov. 8-10, 1971, AIAA Paper 71-1061*. 6 p. 11 refs. Members, \$1.50; nonmembers, \$2.00.

Problems associated with quantitative interpretation of data from correlation-mask sensors are discussed for various resolutions and for the ultraviolet-visible and infrared spectral regions. High-resolution analysis involves line radiation and the contributions of neighboring lines, while the low-resolution treatment includes band structure parameters. Predicted absorption coefficients or band structure parameters must be averaged over the effective bandwidth of each slit. The mechanisms and importance of beam transmittance attenuation by absorption, scattering, and emission are discussed, and a narrow-band mask device is proposed. (Author)

A72-10532 * # Heterodyne method for high specificity gas detection. J. Dimeff, R. W. Donaldson, W. D. Gunter, Jr., D. N. Jaynes, A. P. Margozi, G. J. Deboo (NASA, Ames Research Center, Moffett Field, Calif.), E. A. McClatchie, and K. G. Williams (Arkon Scientific Laboratories, Berkeley, Calif.). *ACS, AIAA, EPA, IEEE, ISA, NASA, and NOAA, Joint Conference on Sensing of Environmental Pollutants, Palo Alto, Calif., Nov. 8-10, 1971, AIAA Paper 71-1064*. 9 p. Members, \$1.50; nonmembers, \$2.00.

This paper describes a new technique for measuring trace quantities of gases. The technique involves the use of a reference cell (containing a known amount of the gas being sought) and a sample cell (containing an unknown amount of the same gas) wherein the

gas densities are modulated. Light passing through the two cells in sequence is modulated in intensity at the vibrational-rotational lines characteristic of the absorption spectrum for the gas of interest. Since the absorption process is nonlinear, modulating the two absorption cells at two different frequencies gives rise to a heterodyning effect, which in turn introduces sum and difference frequencies in the detected signal. Measuring the ratio of the difference frequency signal, for example, to the signal introduced by the reference cell provides a normalized measure of the amount of the gas in the sample cell. The readings produced are thereby independent of source intensity, window transparency, and detector sensitivity. Experimental evaluation of the technique suggests that it should be applicable to a wide range of gases, that it should be able to reject spurious signals due to unwanted gases, and that it should be sensitive to concentrations of the order of 10 to the minus 8th power when used with a sample cell of only 20 cm length. (Author)

A72-10539 # New development of a CW laser radar. D. W. Jackson (Stanford Research Institute, Menlo Park, Calif.). *ACS, AIAA, EPA, IEEE, ISA, NASA, and NOAA, Joint Conference on Sensing of Environmental Pollutants, Palo Alto, Calif., Nov. 8-10, 1971, AIAA Paper 71-1081*. 5 p. Members, \$1.50; nonmembers, \$2.00.

A CW laser radar technique has been developed for the remote measurement of smoke plume opacity. Calculations indicate that it will be possible to modulate a low power continuous laser beam, detect scattered laser light and measure, in real time, the scattering as a function of range, thus deducing plume opacity. Thus, the same characteristics of smoke plumes may be measured as have been done previously with pulsed systems. This technique offers the major advantage over conventional high peak power pulse laser techniques of being completely eye safe. Additional advantages are low cost, simple operation and simple direct readout. (Author)

A72-10554 # An example of atmospheric scattering layer observability. D. M. Cunnold (MIT, Cambridge, Mass.). *ACS, AIAA, EPA, IEEE, ISA, NASA, and NOAA, Joint Conference on Sensing of Environmental Pollutants, Palo Alto, Calif., Nov. 8-10, 1971, AIAA Paper 71-1110*. 8 p. 12 refs. Members, \$1.50; nonmembers, \$2.00.

Consideration of the observability of aerosol and atmospheric scattering layers by a satellite-mounted optical detector for wavelengths of 3000 and 7000 Å. It is shown that an aerosol layer located at 50 km and having a scattering cross section of a sufficient size to explain previous satellite ultraviolet observations should be observable at times when the satellite is located close to the solar occultation angle. Detection techniques by a wide-angle receiver and by a limited field-of-view steerable telescope are compared. (Author)

A72-10555 # Aerosol monitoring by satellite horizon scanning. C. R. Gray, H. L. Malchow, D. C. Merritt, and R. E. Var (MIT, Cambridge, Mass.). *ACS, AIAA, EPA, IEEE, ISA, NASA, and NOAA, Joint Conference on Sensing of Environmental Pollutants, Palo Alto, Calif., Nov. 8-10, 1971, AIAA Paper 71-1111*. 9 p. 11 refs. Members, \$1.50; nonmembers, \$2.00.

A newly-adapted horizon-scanning technique can simultaneously monitor the vertical distribution of aerosols, as well as ozone and neutral atmospheric density, in the stratosphere and mesosphere for both meteorological and ecological application in a global satellite-monitoring program. This paper presents the horizon-inversion techniques which permit the conversion of scattered solar-radiation horizon (limb) profiles into the vertical distribution of aerosol extinction coefficients. Results are given based on real and simulated experimental data. (Author)

A72-10865 Two Dimensional Digital Signal Processing Conference, University of Missouri, Columbia, Mo., October 6-8, 1971, Proceedings. Conference sponsored by the University of Missouri and the Atlantic Richfield Co. Columbia, Mo., University of Missouri, 1971. 347 p. \$7.00.

The papers deal with various aspects of designing and building machines for a variety of visual problems, and examine the utilization of computer pictorial processing in such areas as bio-medicine, image communications, geophysics, and problems of the environment.

V.P.

A72-10871 Objective methods for registering landmarks and determining cloud motions from satellite data. D. J. Hall, R. M. Endlich, D. E. Wolf, and A. E. Brain (Stanford Research Institute, Menlo Park, Calif.). In: Two Dimensional Digital Signal Processing Conference, University of Missouri, Columbia, Mo., October 6-8, 1971, Proceedings. Columbia, Mo., University of Missouri, 1971, p. 10-1-1 to 10-1-9. 10 refs. Navy-supported research.

Cloud photographs are available from geosynchronous weather satellites. Sequences of photographs at about 20-minute intervals, show cloud motions over vast regions of the planet, providing a potential source of useful weather data, particularly over the oceans, where there are few weather-monitoring stations. Our computer programs represent objective methods that require a minimum of human assistance to compute cloud motions. Computer algorithms are described for matching the earth's disk, giving a global registration; a more precise local registration is then achieved by matching landmarks. Accurate registration is needed because the satellite cannot be given an ideal synchronous orbit and perfect attitude stability. We have experimented with landmark templates of sizes 10 x 10 and 20 x 20 picture elements, representing 25-mile and 50-mile squares. An initial coarse scan of the template suggests where to try a succession of fine scans. The disk matching and the template matching are combined in the complete subsystem for registration. Properly registered cloud data are processed by means of the ISODATA clustering algorithm, which represents a cloud pattern by a number of cluster centers. Cloud motions are found by tracking these centers on successive pictures. (Author)

A72-10946 MSDS - An experimental 24-channel multispectral scanner system. E. M. Zaitzeff (Bendix Corp., Aerospace Systems Div., Ann Arbor, Mich.). In: Astronautical research 1970; International Astronautical Federation, Congress, 21st, Konstanz, West Germany, October 4-10, 1970, Proceedings. Amsterdam, North-Holland Publishing Co., 1971, p. 702-711.

Description of the electromechanical scanner, encoding and recording electronics, ground processing operations, and aircraft mounting details of a multispectral scanning system to be flown in a NASA C-130 earth resources aircraft. Scanner operation covers 24 channels assigned to bands between 0.34 and 13 microns. The energy reflected or radiated from underlying terrain is reflected from a 45-deg rotating mirror and introduced into a spectrometer followed by appropriate detectors for the different channels. Calibration sources are explained, together with the electronics equipment. T.M.

A72-11731 # Possibilities and perspectives of carrying out meteorological observations with manned spacecraft (Vozmozhnosti i perspektivy provedeniia meteorologicheskikh nabludenii s pilotiruemykh kosmicheskikh korablei). E. V. Khrunov. (Vsesoiuznaia Nauchnaia Konferentsiia po Voprosam Meteorologicheskogo Obespecheniia Sverkhzvukovoi Aviatsii, Leningrad, USSR, Mar. 24-26, 1971.) *Meteorologiya i Gidrologiya*, Sept. 1971, p. 3-7. In Russian.

Results of experiments performed on the Soyuz manned spacecraft showing the possibility of carrying out meteorological observations from manned spacecraft. Observations of the cloud cover in various climatic zones of the earth are reported, as well as findings regarding the degree of turbidity of the atmosphere, observations of the nighttime horizon of the earth, and observations of snow cover in mountain areas. The results of a complex experiment involving the use of a research vessel and a manned spacecraft photographing the earth's surface are cited. A.B.K.

A72-11777 # An infrared scanner for India. P. R. Pisharoty and T. A. Hariharan (Indian Space Research Organization, Ahmedabad, India). In: International Symposium on Remote Sens-

ing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 19-23.

Outline of some of the main features of an infrared scanner for thermal mapping of land areas and oceans. Of French manufacture, the initial equipment for the Indian remote sensing program will consist essentially of the scanner and four cameras for multiband or multispectral photography. Plans exist for adding more instruments, including a multispectral scanner. F.R.L.

A72-11778 # Some possible uses of optical and radio-physical remote measurements for earth investigations. Iu. K. Khodarev, B. S. Dunaev, B. N. Rodionov, A. L. Serebriakian, Iu. M. Chesnokov, and V. S. Etkin (Akademiia Nauk SSSR, Institut Kosmicheskikh Issledovani, Moscow, USSR). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 99-118.

Consideration of a number of problems associated with remote sensing of the earth. Physical foundations for the solution of the problems are outlined, and radiative characteristics of the earth's surface are investigated. Attention is given to problems of creation of the complex of means for determination of the radiative characteristics of the surface. It is considered that objects and phenomena can be identified on the basis of measurement data delivered by artificial earth satellites. Various experiments dealing with the atmosphere, geology, geography, hydrology, oceanography, and agriculture and forestry are tabulated. F.R.L.

A72-11779 # Features of microwave passive remote sensing. A. E. Basharinov, A. S. Gurevich, and S. T. Igorov (Akademiia Nauk SSSR, Institut Radiotekhniki i Elektroniki, Moscow, USSR). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 119-123.

Evaluation of the possibilities for remote sensing of the earth's surface and atmosphere, using microwave radiation measurements from aircraft. The advantages of such measurements compared to those of infrared and optical measurements include the possibility of making useful measurements under any meteorological conditions and the acquisition of additional geophysical information. The emittance of the surface of the ocean at microwavelengths depends on temperature, surface conditions, and pollution. F.R.L.

A72-11781 # The investigation of natural resources by infrared remote sensing methods. B. V. Shilin, N. A. Guseev, M. M. Miroshnikov, and E. Ia. Karizhenski (Ministry of Geology, Laboratory of Aerial Utilization, Leningrad, USSR). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 133-146. 6 refs.

Results of experiments which demonstrate the feasibility of using IR scanning equipment in conducting various natural science studies. In contrast with aerial photography, in which the image of the landscape is transferred directly to the film, the IR scanner used for thermal mapping must initially convert the optical signal into an electrical signal which, after appropriate processing, is used to modulate a scanning light beam which also generates a corresponding image of a strip of photographic film. The technique described is useful in the areas of geology, geophysics, oceanography, hydrology, forestry, and many others. F.R.L.

A72-11782 # Remote sensing studies of the physical environment. St. Pons area /Hérault, France/ conducted by the Centre de Géographie Appliquée. J. Tricart and G. Lutz (Université Louis Pasteur, Strasbourg, France). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1.

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Ann Arbor, University of Michigan, 1971, p. 147-151. Research sponsored by the Centre National d'Etudes Spatiales and the Institut Géographique National.

Results of a survey of a small rectangular area, using panchromatic air photos, infrared photographic black and white paper prints, true color photos, and infrared false color. In spite of its small surface, the area is rather complicated and varied. It is a transitional one from the geological, climatological, and phytogeographical points of view. The investigation was conducted in such a manner that the interpretation of the remote sensing images could be controlled, tested, and compared with conventional methods. F.R.L.

A72-11784 # Applications of remote sensing to the World Weather Watch and the Global Atmospheric Research Program. B. Zavos (NOAA, Federal Plans and Coordination Div., Rockville, Md.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 207-219.

Discussion of the World Weather Watch (WWW) and the Global Atmospheric Research Program (GARP), which form the operational and research arms respectively of the World Weather Program. The inception and development of the program and the role played by the international meteorological community, composed of developed and developing countries, is reviewed. The extent to which remote sensing of the atmosphere for meteorological purposes can be used is considered. F.R.L.

A72-11785 # Some results of multispectral aerogeophysical measurements of the earth's surface at the Usturt Plateau. B. V. Vinogradov, A. A. Grigor'ev, K. Ia. Kondrat'ev, Iu. I. Rabinovich, and L. I. Chapurskii (Glavnaia Geofizicheskaya Observatoriia, Leningrad, USSR). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 231-236.

Results of optical measurements made on Oct. 12, 1969, of the Usturt Plateau region and the Caspian and Aral Seas from the manned spacecraft Soyuz 6. It is shown that every method of remote sensing yields specific but limited information that is frequently inadequate for the solution of a given problem regarding the condition of the earth's water and dry-land surfaces and the atmosphere. Only the coordinated utilization of a combination of methods for detecting and recording the electromagnetic fields of the earth in various spectral bands, supplementing and complementing each other, can yield sufficiently reliable, complete, and detailed information regarding the natural environment. F.R.L.

A72-11792 * # Subsurface discontinuity detection by microwave radiometry. R. J. Hruby (NASA, Ames Research Center, Moffett Field, Calif.) and A. T. Edgerton (Aerojet-General Corp., El Monte, Calif.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 319-325.

Brief description of a joint program undertaken near Austin and San Antonio, Tex., to detect the presence of subsurface voids such as caverns and tunnels by microwave radiometry. Microwave radiometric temperature measurements using both vertical and horizontal polarization were taken with fixed-view angle traverses across three sites at two locations. No unambiguous correlation between the microwave temperature contours and the subsurface voids was observed at either location, but a correlation between microwave temperature and moisture patterns was observed at both locations. The large microwave temperature anomalies observed at all three sites indicated a sensitivity to near-surface structure and moisture distribution. A close correlation was noted between low soil-bearing strength values and the tunnel location at the San Antonio site. M.M.

A72-11803 # The observation of topographic variations in surface radiative temperatures by remote sensing from a small aircraft. B. J. Garnier (McGill University, Montreal, Canada). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 495-500. 6 refs. Contract No. N00014-68-C-0307.

This paper describes a system for recording surface radiative temperatures by remote sensing with a PRT5 by attaching the instrument to the steps of a light aircraft. Calibration before and after flight and tests for atmospheric attenuation showed observations to be accurate to within a few tenths of a degree C. For maximum efficiency short flights between clearly identifiable check points are desirable. Data were recorded on 1/4-inch magnetic tape, which gave high precision but produced analysis difficulties. It is suggested that strip-chart recording would have given simpler results to analyze at a detail adequate for most resource inventory purposes. (Author)

A72-11804 # Mapping terrestrial radiation emission with a scanning radiometer. R. W. Pease (California, University, Riverside, Calif.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 501-510. 8 refs.

On the basis of experience and data gained from the Barbados experiment (BOMEX), a system has been successfully created for rapidly mapping terrestrial radiation emission from imagery produced by a scanning radiometer. The target area was imaged with a 'new generation' instrument capable of calibration due to constant amplifier gain and internal calibration sources. Although primary cross-calibration between surface and sensor utilized ground control targets, a model was created for systematizing the error induced by intervening air, a model which in the future may reduce dependence upon ground controls. Isoline maps of surface radiance were constructed by choroplethic techniques that integrated the many disparate modulations of energy emission from the surface. A rationale for using remotely sensed data to map surface energy phenomena is elaborated. (Author)

A72-11807 # Microwave determination of low altitude temperature profiles. E. R. Westwater (NOAA, Boulder, Colo.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 585-594. 10 refs. Research supported by the U.S. Environmental Protection Agency.

Demonstration that passive ground-based radiometric measurements of thermal emission by oxygen can provide significant information about low-altitude temperature structure. Theoretical results indicate that rms accuracies of 1 K can be obtained up to 2 km by inversion of fixed-frequency, angular-scan radiometer data with noise levels of 1 K. Statistical inversion techniques are applied to angular scan data to recover various types of temperature profiles. (Author)

A72-11817 * # Implicit determination of multispectral scanner data variation over extended areas. F. J. Krieger (Michigan, University, Ann Arbor, Mich.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 1. Ann Arbor, University of Michigan, 1971, p. 759-777. 9 refs. Contract No. NAS9-9784.

Description of a method by which variations in aerial multispectral scanner data can be accounted for when there is insufficient ground truth information. The data are suitably filtered and smoothed along the flight line, and the reduced results are presented in a form such that the investigator can readily determine the preprocessing that should be used and the spatial extent to which it should be applied. An algorithm is developed for the detection of cloud-shadowed areas. T.M.

A72-11818 # Geometric calibration of the RBV system for ERTS. R. B. McEwen (U.S. Geological Survey, McLean, Va.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 2. Ann Arbor, University of Michigan, 1971, p. 791-807. 5 refs.

The U.S. Geological Survey (EROS program) is cooperating with NASA and RCA in a geometric calibration of the Return Beam Vidicon system for the Earth Resources Technology Satellite. Calibration is essential for register and cartographic referencing of high-resolution photomage maps. It is required by the NASA Data Processing Facility and for USGS research programs. Resolution controls the final output scale, and geometric register imposes the most critical criteria for calibration. Final geometric register with an accuracy of 10 micrometers is sought, and the several functional parameters of geometric register require calibration to higher accuracy. The reseau, the lens focal length, principal point, and radial distortion, and the electronic distortions of TV scanning and reproduction are the major topics of geometric calibration. Preliminary results indicate that the RBV system has stable systematic distortions which can be calibrated. (Author)

A72-11819 # Results obtained from the University of Michigan microwave hologram radar. R. W. Larson, J. S. Zelenka, and E. L. Johansen (Michigan, University, Ann Arbor, Mich.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 2. Ann Arbor, University of Michigan, 1971, p. 809-842. 22 refs. Contract No. F33615-70-C-1433.

Work on an experimental hologram radar system conducted from July 1967 through July 1969 is reviewed. Theoretical considerations for a hologram radar system, applications of a hologram radar, and a description of preliminary testing procedures for the system are presented. The experimental demonstration system is described, and examples of microwave hologram imagery obtained from flight tests both in the single-frequency and two-frequency mode of operation are given. Optical processor configurations and alignment procedures developed for the system are described. V.P.

A72-11822 # Luminescence induced by UV and visible lasers for the remote active sensing of materials from ground, air and space. H. G. Gross and H. A. Hyatt (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 2. Ann Arbor, University of Michigan, 1971, p. 869-888. 17 refs. Research supported by the McDonnell Douglas Astronautics Co.

Results of studies are presented on actively producing luminescence in various materials with lasers. Most of these materials are not noted for having luminescence properties. The potential of this active technique for remote sensing applications from ground, airplane and satellite platforms is described. Results of particular interest are: (1) luminescence can be produced in all the materials studied by irradiation with visible as well as UV laser wavelengths, a fact hitherto neglected in remote sensing applications; (2) either the single or double specificity of excitation and emission spectra, the basis for materials identification and quantification in fluorometry, can be utilized for the remote but precise identification of species by means of the high spectral and spatial resolution and controlled irradiation conditions achievable with lasers, especially with tunable lasers; and (3) nighttime is best for the universal application of this technique, although certain applications are feasible in daytime.

M.V.E.

A72-11825 # Applications of remote sensing to operational weather forecasting. D. S. Cooley (NOAA, National Weather Service, Silver Spring, Md.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 2. Ann Arbor, University of Michigan, 1971, p. 941-949. 10 refs.

Operational uses of remote sensing in the National Weather Service are discussed. The following areas are considered: optical measurement of cloud base height from the ground; radar observation of precipitation; and satellite sensing of atmospheric conditions. Some of the recent remote sensing techniques are described. O.H.

A72-11828 # Experimental applications of multispectral data to natural resource inventory and survey. H. J. Mallon (Metropolitan Washington Council of Governments, Washington, D.C.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 2. Ann Arbor, University of Michigan, 1971, p. 989-1003. 9 refs.

The identification and survey of natural resource materials by remote sensing methods for possible use under emergency conditions is believed to be a feasible and useful means of assessing and corroborating inventory information from other sources. Applications based upon preliminary analysis of multispectral imagery and related data show promise and are being investigated. (Author)

A72-11833 * # Simulation of ERTS RBV imagery. O. Weinstein (NASA, Goddard Space Flight Center, Greenbelt, Md.), B. P. Miller, and J. Barletta (RCA, Astro-Electronics Div., Princeton, N.J.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 2. Ann Arbor, University of Michigan, 1971, p. 1177-1189.

Based on the signal-to-noise ratio, modulation transfer function (MTF), and light transfer characteristics of the return-beam vidicon (RBV) multispectral three-camera subsystem, developed for use on earth resources technology satellites (ERTS), an analytical prediction of the resolvability of ground targets was made as a function of target size, contrast, spectral distribution, and radiance level. To determine whether the analysis was correct, U.S. Air Force targets with various contrasts were utilized to simulate those contrasts and radiance levels that the RBV cameras would see in the actual ERTS scenes. Although the RBV camera used in this test had a somewhat lower signal-to-noise ratio than the flight cameras, the simulation still proved the validity of the theoretical analysis in predicting resolving power performance for any set of input parameters. M.V.E.

A72-11844 # Procedural questions in signature analysis. G. Nagy, G. Shelton, and J. Tolaba (IBM Thomas J. Watson Research Center, Yorktown Heights, N.Y.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 2. Ann Arbor, University of Michigan, 1971, p. 1387-1401. 10 refs.

The object of this paper is to call attention to the futility of expecting small randomly chosen training samples for terrain classification by means of airborne sensors to be representative of the data to be classified. Some experimental evidence is advanced in support of the alternative method of clustering the samples without prior category information and basing the collection of the ground-truth on the results thus obtained. (Author)

A72-11849 * # Results of scatterometer systems analysis for NASA/MSC Earth Observation Sensor Evaluation Program. K. Krishen, N. Vlahos, O. Brandt (Lockheed Electronics Co., Houston, Tex.), and G. Graybeal (NASA, Manned Spacecraft Center, Houston, Tex.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 2. Ann Arbor, University of Michigan, 1971, p. 1451-1473. 15 refs. Contract No. NAS9-5191.

Radar scatterometers have applications in the NASA/MSC Earth Observation Aircraft Program. Over a period of several years, several missions have been flown over both land and ocean. In this paper a system evaluation of the NASA/MSC 13.3-GHz Scatterometer

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System is presented. The effects of phase error between the Scatterometer channels, antenna pattern deviations, aircraft attitude deviations, environmental changes, and other related factors such as processing errors, system repeatability, and propeller modulation, were established. Furthermore, the reduction in system errors and calibration improvement was investigated by taking into account these parameter deviations. Typical scatterometer data samples are presented. (Author)

A72-11858 * # Importance of atmospheric scattering in remote sensing, or everything you've always wanted to know about atmospheric scattering but were afraid to ask. R. E. Turner, W. A. Malila, and R. F. Nalepka (Michigan, University, Ann Arbor, Mich.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 1651-1697. 16 refs. Contract No. NAS9-9784.

Discussion of the effects of atmospheric scattering and/or absorption on discrimination between target and background materials in environmental or natural science remote sensing applications. The spectral region considered lies between 0.4 and 3 microns. The results are presented parametrically and include an interesting effect that neighboring materials have on the spectral character of a target as a result of aerosol scattering by atmospheric haze. M.V.E.

A72-11859 * # Indirect sensing of atmospheric temperature and water vapor using microwaves. P. W. Rosenkranz, D. H. Staelin (MIT, Cambridge, Mass.), F. T. Barath, J. C. Blinn, III, and E. J. Johnston (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 1739-1748.

A prototype of the Nimbus E microwave spectrometer was flown in an airplane over various atmospheric and surface conditions. Effects of clouds and the terrestrial surface on the data are discussed. Using a multiple-regression statistical method of inverting the equation of radiative transfer, estimates of temperature and integrated contents of water vapor and liquid water in the atmosphere below the aircraft were made from the microwave data obtained at high altitude. These estimates are compared with direct measurements made by other experiments on board the aircraft, in both clear atmospheres and in the presence of clouds. (Author)

A72-11860 * # Remote sensing of atmospheric aerosols. A. E. S. Green, A. Deepak, T. Savada, and R. S. Sholtes (Florida, University, Gainesville, Fla.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 1749-1763. 15 refs. NSF Grant No. GA-4479.

Review of the results of a joint determination of size-altitude distributions of atmospheric aerosols, conducted over Gainesville, Fla., on Apr. 17 and 21, 1971, during a period of general air pollution alert over Florida, by means of measurements of the sky brightness intensities within the sun's aureole in coordination with point sampling measurements using an aircraft-borne particle counter. The results reported represent the initial measurements in a broader coordinated program of atmospheric probing using a variety of remote sampling techniques in conjunction with in situ observations. M.V.E.

A72-11861 * # Ground-based passive microwave sensing of temperatures in the stratosphere and lower mesosphere. J. W. Waters (MIT, Cambridge, Mass.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 1765-1776. 22 refs. Grants No. NGL-22-009-016; No. NGL-22-009-421.

Calculations are presented of the brightness temperature emission spectra of the 60-GHz O₂ absorption band lines. Approximately 14 of these lines are predicted to be sufficiently strong for being measurable with state-of-the-art instruments. The intensity of the emission from these lines is shown to be quite sensitive to atmospheric temperature. M.V.E.

A72-11862 * # A computer program to calculate atmospheric effects on infrared wavelength radiation. H. M. Rose, D. C. Anding, and J. Walker (Michigan, University, Ann Arbor, Mich.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 1777-1789.

A computer program is described which is used to calculate atmospheric attenuation and emission for typical remote sensing optical path geometries. The theoretical basis of the program is described and the inputs necessary to running the program are detailed. Considerations of computational accuracy and program limitations and principle utilities are discussed. Several example spectra are presented and discussed. (Author)

A72-11865 * # Passive microwave remote sensing at the University of Bern, Switzerland. K. Kunzi, A. Magun, C. Maetzi, G. Schaerer, and E. Schanda (Bern, Universität, Berne, Switzerland). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 1819-1826. 17 refs.

Several applications of passive microwave sensing and basic research projects in this field which have been carried out by our group are reviewed and some key results are discussed. The main points are: thermal imaging, location and tracking by microwave radiometers, the study of the statistical amplifier gain variations and their influence on the sensitivity of radiometers, the deterioration of radiometric images by imperfect antennas, and the emissivity measurements on anisotropically radiating samples and on a large number of surfaces of natural and artificial materials carried out for the establishment of microwave signatures. Investigations on atmospheric absorption are just now in the starting phase. (Author)

A72-11867 * # Experimental microwave measurements of controlled surfaces. B. R. Jean, J. A. Richerson, and J. W. Rouse, Jr. (Texas A & M University, College Station, Tex.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 1847-1859. 11 refs.

Through experimental measurements of the dielectric constant of a particular soil type, quantitative predictions of apparent temperature were made in a study of moisture effects upon measured apparent temperatures. Comparison of the predicted values to actual measurement data shows good agreement for large, smooth, homogeneous targets, but for targets of the order of a resolution cell size a marked decrease in sensitivity to moisture effects is noted. Also, an oil spill on a water surface was simulated in an attempt to model the emission from an oil-water interface. The apparent temperature anomaly observed in this case, too, is discussed. M.V.E.

A72-11870 * # An analysis of pulse compression techniques for satellite-borne radar altimetry. W. R. Carmichael (General Electric Co., Aircraft Equipment Div., Utica, N.Y.). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 1895-1904.

Signal return characteristics are derived for an uncoded pulse, a frequency coded pulse, and for a phase coded pulse for radar altimetry. Modeling the extended ocean as a Rayleigh fluctuating surface, it is shown that the return signal is a nonstationary random

process. Simple models are presented for each of the three receivers. The covariance function and mean of the uncoded signal return are derived at the receiver input and the square-law detector output. The signal return for each of the coded pulses is derived and plots of the mean returns at the input and detector output presented. Sensitivities of the particular average detected waveshapes to altitude, antenna beamwidth and attitude pointing errors are evaluated and discussed. (Author)

A72-11888 # The basic directions of the development of aerial methods for the study of natural resources of the USSR. V. B. Komarov (Ministry of Geology, Laboratory of Aeromethods, Leningrad, USSR). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 2275-2280.

Aerial survey techniques used in the Soviet Union in natural resources studies are reviewed, covering the application of aerial photography for inventories of forests, soils, vegetation and unarable areas, for assessment of hydrological features of land masses and sea, and for wildlife management. Some details are given on photograph interpretation, uses of fast aerospectrometers, speedier data processing, and multispectrum cameras with lasers. V.Z.

A72-11889 # The determination of the meteorological characteristics of the atmosphere and the earth's surface from airborne measurements of passive microwave radiation. Iu. I. Rabinovich, G. G. Shchukin, and V. V. Melent'ev (Glavnaia Geofizicheskaya Observatoriia, Leningrad, USSR). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 2281-2294.

Assessment of the possibility of using millimeter and centimeter wave radiation to determine the characteristics of precipitation and the earth's surface beneath a cloud cover. The results of calculations of the microwave radiation from smooth water surfaces at various temperatures and salinities are presented, with allowance for the dependence of the data on dielectric-constant and conductivity variations with temperatures and salinity. The results of determinations of the radiation properties of natural earth surfaces by making two measurements of the radio brightness temperature of a shielded cavity are also cited. A.B.K.

A72-11890 # Radar in the Amazon. L. H. A. de Azevedo (Ministério das Minas e Energia, Departamento Nacional da Produção Mineral, Rio de Janeiro, Brazil). In: International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3. Ann Arbor, University of Michigan, 1971, p. 2303-2306.

A description is presented of the features of the Project RADAM (for Radar Amazon) which is currently underway in the Amazon region of Brazil. This program seeks to use side-looking radar imagery, in conjunction with limited amounts of multiband aerial photography taken from high and low altitudes, to map the mineral, vegetation, soil, and water resources. ERTS experiments planned as an expansion of the radar survey are also described. O.H.

A72-12017 Problems inherent in remote sensing of the earth's surface using thermal infrared radiation (Zur Problematik der Fernerkundung der Erdoberfläche mit Hilfe der thermischen Infrarotstrahlung). D. Lorenz (Meteorologisches Observatorium, Hohenpeissenberg, West Germany). *Bildmessung und Luftbildwesen*, vol. 39, Nov. 1, 1971, p. 235-242, 11 refs. In German.

For uncovered soils, mainly by using the so-called heat-balance equation, an investigation has been made to determine how measurements of thermal infrared radiation can be used for remote sensing of the earth. It has been found that nighttime measurements in the presence of a cloudless sky and daytime measurements in the

presence of a thick uniform cloud layer yield the most favorable results. Two examples of measurements are discussed. In addition, model calculations and model measurements are suggested. O.H.

A72-12128 International Telemetering Conference, Washington, D.C., September 27-29, 1971, Proceedings. Conference sponsored by the International Foundation for Telemetering, the Instrument Society of America, and the Electronic Industries Association. Woodland Hills, Calif., International Foundation for Telemetering (ITC Proceedings. Volume 7), 1971. 721 p. \$20.

Procedures and equipment for transmission, modulation, filtering, detection, and display of telemetry data are described in reports dealing with educational applications, picture processing, digital communications, space uses, biotelemetry, transportation systems, optics, and microwave links. Topics treated include computer manipulation of image data, image data compression methods, extreme value theory performance tests, memory controlled PCM encoders; an interplex modulation scheme for space station communications, hybrid IC techniques in biotelemetry, improved performance pulse modulation procedures, laser modulation techniques, magnetic recording and reproducing equipment, and a reentry telemetry system. T.M.

A72-12162 A multispectral scanner data decommutator/processor for the Earth Resources Technology Satellite. E. L. Waltz (Bendix Corp., Aerospace Systems Div., Ann Arbor, Mich.). In: International Telemetering Conference, Washington, D.C., September 27-29, 1971, Proceedings. Woodland Hills, Calif., International Foundation for Telemetering, 1971, p. 567-579.

This paper describes the design of the telemetry decommutator/processor for multispectral scanner data to be returned by the first two Earth Resources Technology Satellites (ERTS). This unit, referred to as the Multispectral Scanner Tape Decommutator/Processor (MSS TDP), is a versatile data handling system which accepts multiple-track tape inputs, providing output formats compatible with a multiple-track tape recorder or a single channel film recorder. The system is organized as a parallel processor, being capable of decommutating and formatting five spectral bands of digital video data. Synchronization and decommutation of skewed multiple-track data is performed with housekeeping and calibration data being transferred to a control computer. A six scan line buffer is asynchronously loaded and synchronously unloaded to remove data skew and reformat the video data. The unit includes a high-speed arithmetic processor which performs radiometric calibration of a single spectral band of video data prior to film recording. The primary function of the MSS TDP will be the processing of receiving site data tapes for conversion to film images. (Author)

A72-12199 High-altitude color photos. L. A. Eyre (Florida Atlantic University, Boca Raton, Fla.). *Photogrammetric Engineering*, vol. 37, Nov. 1971, p. 1149-1153. U.S. Geological Survey Contract No. 14-08-001-10936.

Demonstration that declassified high-resolution color and color-infrared photographs from 18-km altitude provide a new and useful tool for regional analysis. Because under ideal laboratory conditions a ground resolution of four meters is combined with a coverage of 22.5 sq km on each transparency, both macroscale patterns and a high degree of detail are capable of accurate analysis. Use of this imagery to record 13 years of change in a rapidly developing area of south Florida suggests that the imagery has many advantages for a wide range of objectives. (Author)

A72-12376 EASCON '71; Electronics and Aerospace Systems Convention, Washington, D.C., October 6-8, 1971, Record. Convention sponsored by the Institute of Electrical and Electronics Engineers. New York, Institute of Electrical and Electronics Engineers, Inc. (IEEE Publication 71 C 34 - AES), 1971. 272 p. Members, \$12.50; nonmembers, \$14.50.

08 INSTRUMENTATION AND SENSORS

Digital matched filters using fast Fourier transforms, splash-detection radar digital signal processing, detection of targets in non-Rayleigh sea clutter, and radar measurement accuracy in log-normal clutter are among the topics covered in contributions concerned with results in radar signal processing. Other contributions include industrial and biomedical transducers, air traffic control, oceanographic and atmospheric technology, technical requirements and resource allocation in aerospace-borne earth resources exploration, and current problems in radar technology.

M.V.E.

A72-14306 # **Satellites in the service of geography (Satelliten im Dienste der Geographie).** H. G. Gierloff-Emden, F. Wieneke (München, Universität, Munich, West Germany), and G. Kritikos (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Satellitenelektronik, Oberpfaffenhofen, West Germany). *Weltraumfahrt Raketentechnik*, vol. 22, Oct.-Nov. 1971, p. 165, 166, 168-170. 9 refs. In German.

A photograph obtained with Apollo 9 shows various clouds of smoke indicating the directions of the winds prevailing in the area. Another photograph shows the cloud structure in the western part of Europe. Other photos presented illustrate an automatic mapping procedure and the exploration of hydrographic-morphological processes on the basis of satellite photos.

G.R.

A72-15610 **Environmental effects on radar and radiometric systems at millimeter wavelengths.** K. A. Richer (U.S. Army, Ballistics Research Laboratories, Aberdeen Proving Ground, Md.). In: *Submillimeter waves; Proceedings of the Symposium*, New York, N.Y., March 31-April 2, 1970. I Brooklyn, N.Y., Polytechnic Press; New York, Wiley-Interscience, 1971, p. 533-543.

Millimeter-wavelength signals are being investigated to determine their possible use in a near earth environment for remote detection purposes. Both radiometric and radar systems concepts are being considered. A typical radiometric application is discussed. Severe attenuation of the signal occurs in the atmospheric propagation path at certain wavelengths as a result of resonance absorption by water vapor and oxygen molecules. Undesirable radar reflections from the terrain occur when operating at low grazing angles. The magnitude of the interference is a function of antenna beamwidth and reflectivity of the intervening terrain. The effect of these multipath signals on the 70 GHz antenna pointing error is treated. The objects to be detected are often partially obscured by foliage and trees. Radar and radiometric measurements of this effect at 35, 70, and 140 GHz are discussed.

M.M.

A72-15756 **Remote sensing sans satellites.** P. Stubbs. *New Scientist*, vol. 52, Dec. 16, 1971, p. 148-150.

Examination of the capabilities of sounding rockets and balloons for remote sensing. These methods, cheaper than orbiting satellites, can be of use to developing nations by disclosing what resources they have. In addition to mineralogical surveys, land use surveys and hydrological assessments can be carried out. A great advantage that sounding rockets have over satellites is the elimination of the need for a large organization. Some techniques available for remote sensing are outlined, and particulars of the Earth Resources Satellite ERTS A, to be launched by NASA in the spring of 1972, are given.

F.R.L.

A72-16690 # **Combined radar-acoustic sounding system.** J. M. Marshall (ESL, Inc., Sunnyvale, Calif.), A. M. Peterson (Stanford University, Stanford, Calif.), and A. A. Barnes, Jr. (USAF, Cambridge Research Laboratories, Bedford, Mass.). *Applied Optics*, vol. 11, Jan. 1972, p. 108-112. 9 refs. Contract No. AF 19/628-6152.

Tracking of 85 Hz (4 m) acoustic pulses directed vertically into the lower atmosphere was made by a 36.8-MHz (8-m) pulse Doppler radar. SNRs in excess of 10 dB were obtained up to a height of 1.5 km in the initial tests under calm wind conditions. The technique is

assessed as one with a potential for providing temperature soundings of the lower atmosphere for air pollution studies and short-range terminal weather forecasts.

V.Z.

A72-17366 **Geophysics 3. Part 3 (Geophysik 3. Teil 3).** Edited by K. Rawer. Berlin, Springer-Verlag (Handbuch der Physik. Volume 49/3), 1971. 542 p. \$45.80. In German, English, and French.

Various techniques for measuring magnetism are described, including aeromagnetic surveying with the fluxgate magnetometer and geophysical applications of high resolution magnetometers. Attention is given to features of magnetic disturbances, current theories, and the conventional data figures characterizing magnetic activity. The natural very low frequency phenomena, which can only be understood by the presence of a magnetic field in the natural plasma near the earth, are described.

G.R.

A72-17370 **Classical methods of geomagnetic observations.** V. Laursen and J. Olsen. In: *Geophysics 3. Part 3*. Berlin, Springer-Verlag, 1971, p. 276-322. 138 refs.

The geomagnetic field is readily measurable even by means of very simple instruments. At most magnetic observatories the variations of the magnetic vector are recorded as variations of three of its components or elements. The theory of the unifilar variometer is discussed together with the variometer for declination, the variometer for horizontal force, variometers for X and Y, a variometer for vertical force, ordinary magnetographs, and quick-run magnetographs. Various aspects of the direct determination of the geomagnetic elements considered include the determination of the declination, the determination of the inclination, the determination of the horizontal force by the method of Gauss-Lamont, by EM methods and by torsion magnetometers, and the determination of the vertical force by EM methods and by balance magnetometers.

G.R.

A72-17371 **Recent measurement methods of geomagnetics (Neuere Messmethoden der Geomagnetik).** H. Schmidt and V. Auster. In: *Geophysics 3. Part 3*. Berlin, Springer-Verlag, 1971, p. 323-383. 123 refs. In German.

The measurement of components of the magnetic field vector with the aid of bar magnets in connection with electronic indicating and control devices is discussed, giving attention to compensation procedures, deflection methods, and approaches based on the determination of the time of oscillation of standard magnets. Other methods for the determination of the field vector components are based on the use of inductances. Some of these methods utilize inductance coils. Other methods include approaches employing saturable core devices. Another class of magnetic field determination methods makes use of the splitting up of energy levels in atoms or atomic nuclei in the presence of a magnetic field. Some methods are based on paramagnetic electron resonance and the Overhauser effect. Problems of data processing in connection with geomagnetic measurements are also considered.

G.R.

A72-17372 **Three-component airborne magnetometers.** P. H. Serson and K. Whitham. In: *Geophysics 3. Part 3*. Berlin, Springer-Verlag, 1971, p. 384-394. 11 refs.

Two basic considerations governed the overall design of the magnetometer discussed. First, the instrument was to present magnetic results in a form as close as possible to that required for the preparation of magnetic charts. The second aim was that the accuracy of measurement should be 0.1 deg in declination, 0.0001 Oe in the horizontal component, and 0.0001 Oe in the vertical component. The direction reference system is discussed, together with the magnetometer design and the accuracy of survey results.

G.R.

A72-17373 **Aeromagnetic surveying with the fluxgate magnetometer.** J. R. Balsley. In: *Geophysics 3. Part 3*.

Berlin, Springer-Verlag, 1971, p. 395-421. 67

refs.

The basic element of most of the modern airborne magnetometers is the fluxgate or saturable core inductor. The fluxgate magnetometer makes use of the effect of the earth's magnetic field on the variation of permeability with intensity of magnetization in ferromagnetic material used in the detecting element. The magnetometers, being sensitive, small, and easily oriented are ideally suited for aerial operations. Aspects of the operation of airborne magnetometers are discussed together with the compilation of field data, and the interpretation of the results. G.R.

A72-17374 Geophysical applications of high resolution magnetometers. P. J. Hood. In: *Geophysics* 3. Part 3. Berlin, Springer-Verlag, 1971, p. 422-460. 63 refs.

The various types of nuclear magnetometers include proton precession magnetometers, the Overhauser type, and optical absorption magnetometers. High resolution magnetometers are used in magnetic observatories to record the temporal variations of the earth's magnetic field. In archaeological investigations of buried sites of historical interest the magnetometers are employed to delineate such features as kilns, ditches, and walls. Other applications of the instrument are in satellite investigations of the magnetic fields of planets such as earth and Venus, and in mineral prospecting surveys. G.R.

A72-17385 # Remote sensing of terrestrial resources (Télé-détection des ressources terrestres). A. Alouges (Centre National d'Etudes Spatiales, Paris, France). *Sciences et Industries Spatiales*, vol. 7, Dec. 1971, p. 46-50. In French.

Discussion of the role of CNES in airborne experiments to determine terrestrial resources. CNES has coordinated efforts which, up to now, have been dispersed, and has demonstrated the characteristics of remote sensing as opposed to classical photodetection. Research has been conducted in the fields of oceanography, agriculture, geology, hydrology, and human activities. The experiments have made use of various detectors, including the French 'Cyclope' infrared scanner. Studies of water pollution and of vegetation and soils are reported. F.R.L.

A72-17426 Photo-optical instrumentation: Present and future developments; Proceedings of the Seminar-in-Depth, Tokyo, Japan, June 25-28, 1970. Seminar sponsored by the Society of Photo-optical Instrumentation Engineers. Edited by T. Uyemura (Tokyo, University, Tokyo, Japan) and E. B. Turner (Aerospace Corp., El Segundo, Calif.). Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers (SPIE Seminar Proceedings. Volume 22), 1971. 162 p. Members, \$14; nonmembers, \$22.

Topics discussed include giant-pulse ruby laser holography, the application of photopolymers to holography, materials used as high-speed photodetectors, terrain representation in three-dimensional coordinates, remote sensing for earth resources applications from aircraft and satellite-borne platforms, limitations on photography of the earth from outside the atmosphere, optical instrumentation for rocket and satellite tracking, a new lightweight eye marker recorder, a research simulator for human engineering studies, the use of high-speed photography in plasma research and in the observation of explosive events, the use of optical techniques for heart research data acquisition, a semiautomatic device for measuring bubble chamber tracks, a device for off-axis modulation transfer function measurements, and the use of stereoscreens to achieve three-dimensional image displays. A.B.K.

A72-17430 * A survey of multispectral remote sensing techniques for earth resources applications. H. G. Pascalar (Aerojet-General Corp., El Monte, Calif.). In: *Photo-optical instrumentation: Present and future developments; Proceedings of the Seminar-in-Depth, Tokyo, Japan, June 25-28, 1970*. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1971, p. 47-64. 29 refs. Contract No. NAS5-9680.

Remote sensing for earth resources applications has as its objective the collection and interpretation of information on all environmentally significant features of the atmosphere, oceans, and land surfaces. This information is most effectively gathered by airborne and satellite borne imaging systems. These systems operate at a variety of wavelengths extending from the visual spectrum, through the infrared and into the centimeter wavelengths of the microwave band. A comparison is made of the signal characteristics at these spectrum regions. In particular, the ability of microwave radiometric imaging to augment visual and infrared imaging is discussed. Recent developments in electronically scanned microwave radiometric sensors are described, together with methods of optimizing microwave data display. Results achieved with integrated display systems for both microwave and optical data are presented, together with projections for future applications. (Author)

A72-17789 Thermal infrared imaging in aerial surveys of natural resources. M. M. Miroshnikov, E. Ia. Karizhenskii, B. V. Shilin, and N. A. Gusev. (*Optiko-Mekhanicheskaya Promyshlennost'*, vol. 38, Mar. 1971.) *Soviet Journal of Optical Technology*, vol. 38, Mar. 1971, p. 131-138. 6 refs. Translation.

A thermal ir imaging technique using a device with two separate amplifier-recorder channels was used for aerial photographic and visual recordings of terrain images in aerial surveys of natural resources carried out in 1967 over dormant active volcanos in Kamchatka. The scanning device included an optical head, a switching and amplifying module, the two high-resolution high-sensitivity channels, a control and power supply module and a radiation detector cooling system. The specifications, design features and performance of a device of this type are discussed. A block diagram of the device and typical aerial photographs of various terrains taken by this technique are given. V.Z.

A72-18232 # Multispectral camera systems (Multispektrale Kamerasysteme). Ph. Hartl and P. Seige (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Satellitenelektronik, Oberpfaffenhofen, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Fernerkundung der Erdoberfläche, Munich, West Germany, Dec. 9, 1971, Paper 71-135*. 13 p.

In multispectral recording the EM energy radiated by the surface of the earth is recorded for each wavelength range separately. Information concerning the ground characteristics which can be obtained by a comparison of the various spectral ranges is not available by considering a color picture only. Panchromatic film and color film are among the films used. Approaches for designing multispectral camera systems are discussed, giving attention to the opto-electronic system and the TV camera tube required. A description of the camera system of the ERTS project is given together with some details of the WISP system of TRW, and the basic principles of a new multispectral camera system presently being developed. G.R.

A72-18233 # Effect of the atmosphere on the recognition of earth surface signatures (Einfluss der Atmosphäre auf die Erkennung von Erdoberflächen-Signaturen). H. J. Bolle (München, Universität, München, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Fernerkundung der Erdoberfläche, Munich, West Germany, Dec. 9, 1971, Paper 72-130*. 52 p. 18 refs. In German.

Remote sensing of the earth's surface from high altitudes suffers from a reduction of the signature contrast due to the atmosphere. Responsible for this degradation are the changing illumination conditions, the diminuation of the target radiation as well as the airlight produced in the atmosphere. The relevant scattering, absorption and emission processes, and their specific influence on the recognition of surface signatures are discussed. (Author)

A72-18234 # General survey concerning the possibilities of remote sensing (Allgemeine Übersicht über die Möglichkeiten des

Remote Sensing). J. Bodechtel (München, Universität, Munich, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Fernerkundung der Erdoberfläche, Munich, West Germany, Dec. 9, 1971, Paper 71-128.* 6 p. In German.

A number of photographic methods and approaches based on scanning, scatterometer, radiometer, and vidicon systems are used for remote sensing applications. In many cases it is important to supplement information obtained by satellite with details from aerial photos and ground observations. Aspects of ground resolution are discussed, together with the use of automation for data evaluation. The unique possibilities presented by a satellite in the study of relations involving large areas are pointed out. G.R.

A72-18328 Image resolutions for ERTS, Skylab and Gemini/Apollo. A. P. Colvocoresses (U.S. Geological Survey, McLean, Va.). *Photogrammetric Engineering*, vol. 38, Jan. 1972, p. 33-35. 12 refs.

The images expected from ERTS and Skylab are compared with those already obtained from Gemini/Apollo, in terms of the photographic criterion of resolution. The comparison results indicate that objects to be resolved on ERTS imagery must be of at least twice the dimension of those resolved on Gemini/Apollo, whereas Skylab will resolve objects considerably smaller (0.7 of Gemini/Apollo). M.V.E.

A72-18453 High frequency generation and amplification: Devices and applications; Proceedings of the Third Biennial Cornell Electrical Engineering Conference, Cornell University, Ithaca, N.Y., August 17-19, 1971. Conference sponsored by the Cornell School of Electrical Engineering and the U.S. Navy. Ithaca, N.Y., Cornell University (Cornell Electrical Engineering Biennial Conference Proceedings. Volume 3), 1971. 464 p. \$17.

Research reports dealing with both the properties and applications of solid state and quantum electronic devices. Applications papers consider future social implications of solid state device technology, monitoring of pollutants in the atmosphere, use of solid state microwave devices in airborne radars, Gunn devices applied to miniaturized aircraft altimeters, new uses for superconducting Josephson junctions, laser frequency standards, and new possibilities for chemical lasers. A wide variety of high-frequency electronic generators and amplifiers is covered, including IMPATT and TRAPATT avalanche diodes, Gunn oscillators, LSA mode oscillators, transistors, chemical lasers, junction lasers, and barrier injection transit time low-noise devices made with silicon.

Individual items are abstracted in this issue.

T.M.

A72-18615 # Interdisciplinary applications and interpretations of remotely sensed data. G. W. Petersen and G. J. McMurtry (Pennsylvania State University, University Park, Pa.). In: *Space for mankind's benefit; Proceedings of the First International Space Congress*, Huntsville, Ala., November 15-19, 1971. Preliminary Volume. Huntsville, Ala., Huntsville Association of Technical Societies, 1971, p. 14-1 to 14-12.

The implications of remote sensing for regional resource management are discussed. The equipment used in remote sensing, such as multiband and conventional aerial cameras, spectral and optical mechanical scanners, radar, unmanned (ERTS) and manned (Skylab) satellites, is briefly reviewed. The participation of Pennsylvania State University in the organization and management of projects involving the use of remotely sensed data of earth resources is outlined. The potential benefits of applying remote sensing techniques to the resources of the largest undeveloped watershed of the Northeastern United States, the Susquehanna River Basin, are discussed. M.V.E.

A72-19145 * Ogo 5 magnetic-field data near the earth's bow shock - A correlation with theory. J. K. Guha, D. L. Judge, and J. H. Marburger (Southern California, University, Los Angeles, Calif.).

Journal of Geophysical Research, vol. 77, Feb. 1, 1972, p. 604-610. 11 refs. Contract No. NAS5-9098.

Magnetic-field data obtained in the earth's bow-shock region with a high-resolution triaxial fluxgate magnetometer aboard the Ogo 5 satellite have been correlated with a theory of Tidman and Northrop (1968). These authors have shown that either of two hypotheses about the nature of low-frequency magnetic waves could be invoked to explain previous observations. We have observed exponentially decaying upstream waves that are consistent with only one of these hypotheses. This observation allows use of the theory to infer the local shock velocity and frequency of driving currents within the shock. This method of finding the shock velocity is less sensitive to errors in the plasma parameters than is the method based on the Rankine-Hugoniot relations. (Author)

A72-19601 * # Return-beam vidicon multispectral camera system for ERTS A and B. B. P. Miller (RCA, Astro-Electronics Div., Princeton, N.J.). (*European Space Symposium on Applications Satellites, Berlin, West Germany, May 24-26, 1971.*) *British Interplanetary Society, Journal*, vol. 25, Jan. 1972, p. 1-11. Contracts No. NAS5-11621; No. NAS5-21094.

This paper describes the return-beam vidicon camera system that RCA is developing for use in the ERTS A and B missions. The major parameters of the two-inch return-beam vidicon camera subsystem are explained, and its performance characteristics are given. The relationship of the three-camera subsystem and the associated ground stations is illustrated. A multispectral aerial photograph is shown which is a simulation of a scene taken on the Apollo 9 mission. The simulated scene was made by the return-beam vidicon camera and a laser-beam image reproducer, and is representative of a typical scene as it would be viewed from space during an ERTS mission. (Author)

A72-19657 * Performance evaluation of the two-inch return-beam vidicon three-camera subsystem. B. P. Miller, G. A. Beck, and J. M. Barletta (RCA, Astro-Electronics Div., Princeton, N.J.). (*Society of Motion Picture and Television Engineers, Semi-annual Technical Conference and Equipment Exhibit, 110th, Montreal, Canada, Oct. 3-8, 1971.*) *SMPT, Journal*, vol. 81, Feb. 1972, p. 105-111. 6 refs. Contracts No. NAS5-11621; No. NAS5-21904.

A very-high resolution multispectral television camera system is being developed for NASA for use on the Earth Resources Technology Satellite (ERTS) program. There are three cameras in the system, each viewing the same area but operating in the blue-green, red and near-infrared spectral bands. In the laboratory the cameras' limiting resolution is 4500 TV lines over the 25 x 25-mm image format of the Return Beam Vidicon (RBV). Analysis of typical ERTS scenes shows that actual contrast ratios will be much lower than those of laboratory test targets. A model was developed to predict the resolving power performance of the RBV camera under realistic conditions. The methods used are applicable to all types of imaging systems. To verify the model, tests were conducted using the RBV camera, a laser-beam image reproducer and a series of AF tribar test patterns of known values of contrast. As a more graphic demonstration, simulated multispectral images were generated using color-IR photographs from Apollo 9. (Author)

A72-20220 Laser applications. Volume 1. Edited by M. Ross (McDonnell Douglas Astronautics Co., St. Louis, Mo.). New York, Academic Press, Inc., 1971. 314 p. \$16.

Applications of holography are discussed together with laser applications in metrology and geodesy, and the laser gyro. Other subjects considered include machining and welding applications for lasers, and laser communications.

G.R.

A72-21334 Expanding the horizons of multispectral photography. N. Gutlove and R. Bashe (Fairchild Camera and Instrument Corp., Syosset, N.Y.). *Optical Spectra*, vol. 5, Oct. 1971, p. 23-27.

Review of the widening range of scientific and industrial applications of multispectral photography and precision digital image processing techniques. Following a brief description of the data collection and image analyzing systems and techniques, earth science and technical applications are discussed. A recently proposed program for automatic classification of natural resource features from multispectral and color separation photography is to use film scanning equipment that will prepare digital tapes of photographic imagery to serve as a basis for computer classification of agricultural, geological, forestry, and hydrological features. Applications of digital image processing techniques to printing promise a virtual revolution in these fields in the next ten years. M.V.E.

A72-21951 Space applications of camera tubes; International Colloquium, Paris, France, November 23-25, 1971, Proceedings (Applications spatiales des tubes de prises de vues; Colloque International, Paris, France, November 23-25, 1971, Proceedings). Colloquium sponsored by the Centre National d'Etudes Spatiales, Paris, Centre National d'Etudes Spatiales, 1971. 347 p. In French and English. \$24.

The conference was held in order to discuss present possibilities of using camera tubes in applications satellites, scientific satellites, rocket probes or balloons. The papers are categorized under the headings of space astronomy, applications satellites, development of camera tubes, stabilization problems, and image processing. F.R.L.

A72-21965 # Conditions for picking up the terrestrial surface from space (Conditions de la prise de vues de la surface terrestre depuis l'espace). A. Alouges (Centre National d'Etudes Spatiales, Brétigny-sur-Orge, Essonne, France). In: Space applications of camera tubes; International Colloquium, Paris, France, November 23-25, 1971, Proceedings. Paris, Centre National d'Etudes Spatiales, 1971, p. 185-190. In French.

Observation of the terrestrial surface from a space platform for the purpose of studying certain properties of that surface. The technique of remote sensing makes use of a carrier vehicle, detectors, a system of data transfer, and ground processing stations. The radiation sources may be either from the object itself or from outside. The effects of the atmosphere, spectral properties of the surface, and the resolution and transmission of information are discussed. F.R.L.

A72-22317 Objectives and capabilities of the Skylab S-193 altimeter experiment. L. S. Miller (Research Triangle Institute, Research Triangle Park, N.C.) and D. L. Hammond (U.S. Navy, E. O. Hulburt Center for Space Research, Washington, D.C.). (Institute of Electrical and Electronics Engineers, Annual International Geoscience Electronics Symposium, 3rd, Washington, D.C., Aug. 25-27, 1971.) IEEE Transactions on Geoscience Electronics, vol. GE-10, Jan. 1972, p. 73-79. 14 refs.

This paper presents a summary of the experimental objectives and spacecraft instrumentation associated with the S-193 altimeter experiment for the 1973 Skylab mission. The experiment is, in general terms, directed toward geodetic altimetry and the acquisition of technical information needed to improve future precision altimeter designs, remote sensing of oceanographic and surface features, and measurement of basic electromagnetic scattering characteristics. A detailed discussion of the experiments associated with these objectives is given and the paper concludes with a review of the spacecraft hardware characteristics. (Author)

A72-23304 # Multispectral remote sensing. C. E. Olson (Michigan, University, Ann Arbor, Mich.). In: Internationale Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 2. Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 679-688. 5 refs.

It has long been realized that changing film or filter could enhance photographic tone contrast for certain objects and reduce tone contrast for others. Multispectral imagery can be obtained with camera, line scanning, and radar systems. To date, automated interpretation devices have been able to utilize only one of the elements used by the human. This one element is tone, or the relative intensity of the energy returned or received from an object. Plans for earth resources observation satellites are also discussed. G.R.

A72-23926 Symposium on Electron, Ion, and Laser Beam Technology, 11th, University of Colorado, Boulder, Colo., May 12-14, 1971, Record. Symposium sponsored by the Institute of Electrical and Electronics Engineers, American Vacuum Society, University of Colorado, and National Science Foundation. Edited by R. F. M. Thormley. San Francisco, San Francisco Press, Inc.; New York, Institute of Electrical and Electronics Engineers, Inc., 1971. 700 p. Members, \$18.75; nonmembers, \$25.

Topics discussed include electron beam and laser beam recording, an MOS memory produced by ionizing radiation, the characteristics and performance of vesicular films, an embedded element storage array, a telescoping drift tube used in the deposition of high doses of ionizing radiation, electron beam equipment operating in a retarding-field mode for examining large areas of microelectronic specimens, and the testing of microcircuit arrays by means of high-voltage low-current electron beams. Also discussed are topics in beam physics, laser technology, fabrication technology, molecular laser interactions, the generation of high-power electron beams, computer-controlled microfabrication, relativistic electron beams, ion sources, and thermal effects of beams. A.B.K.

A72-24444 * # Manned operation of earth resources surveys from space. O. G. Smith (NASA, Manned Spacecraft Center, Houston, Tex.). American Institute of Aeronautics and Astronautics, Man's Role in Space Conference, Cocoa Beach, Fla., Mar. 27, 28, 1972, Paper 72-234. 7 p. Members, \$1.50; nonmembers, \$2.00.

The Earth Resources Experiment Package (EREP) which will be flown on the Skylab in 1973 is discussed. The EREP facility includes a multispectral photographic facility (2 camera system), an infrared spectrometer, a multispectral scanner, a microwave radiometer/scatterometer and altimeter, and an L-band radiometer. It also includes a control and display panel, a viewfinder tracking system, and a 28-track magnetic tape recorder. The tasks performed by the crew in the experiment are examined. V.P.

A72-24747 Airborne infrared radiance measurements /10- to 12-micron wavelength/ off tropical east-coast Australia. C. M. R. Platt (Commonwealth Scientific and Industrial Research Organization, Div. of Atmospheric Physics, Aspendale, Victoria, Australia). Journal of Geophysical Research, vol. 77, Mar. 20, 1972, p. 1597-1609. 24 refs.

Radiometric measurements of upward vertical radiance from the sea surface in the 10- to 12-micrometer wavelength interval indicate that the water-vapor absorption coefficient is dependent on water-vapor content. This dependence is found to be in qualitative agreement with laboratory results. The contribution from hygroscopic aerosols appears to be small. O.H.

A72-25076 Symposium on Meteorological Observations and Instrumentation, 2nd, San Diego, Calif., March 27-30, 1972, Preprints. Symposium sponsored by the American Meteorological Society. Boston, American Meteorological Society, 1972. 287 p. In English and French. Members, \$15.; nonmembers, \$20.

Observational instrumentation and data processing techniques are described and evaluated from the viewpoint of relevance to the total environmental data needs of the present and future. Efforts directed at minimizing the data set needed for initiating a macroscale

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prognosis are reviewed, together with numerical models characterizing future meteorological observation systems. The use of reference radiosondes, real-time pilot reports, ground-based remote sensors, acoustic Doppler measurements, fluidic wind sensors, radio altimeters, spectrophotometers, hygrometers, and other devices is described. Emphasis is placed on the definition of user requirements, improvement of accuracy and reliability, and adoption of meaningful data standards.

T.M.

A72-25097 # The current state of precision radiometry in the meteorological and geo-astronomical sciences. A. J. Drummond (Eppley Laboratory, Inc., Newport, R.I.). In: Symposium on Meteorological Observations and Instrumentation, 2nd, San Diego, Calif., March 27-30, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 249-261. 47 refs.

Applications of precision radiometric techniques in meteorology and geo-astronomy are reviewed in the light of the latest developments with international cooperation involving East Germany, Japan, USSR, U.S., Canada, Australia, and West Germany. The topics include the fundamental laboratory radiometric references, the international pyrhelimetric scale, transfer calibrations to secondary radiometers, and solar radiation measurements aloft. Work carried out at the Eppley Laboratory in the development of black bodies is discussed in some detail.

V.Z.

A72-26083 # Radiometric measurements of temperature profiles in the planetary boundary layer. C. R. Hosler (NOAA, Washington, D.C.) and T. J. Lemmons (U.S. Environmental Protection Agency, National Environmental Research Center, Research Triangle Park, N.C.). *Journal of Applied Meteorology*, vol. 11, Mar. 1972, p. 341-348. 6 refs.

A ground-based 5-mm wavelength radiometer, named the Radiometric Thermasonde, has been developed. Typical vertical temperature profiles, derived from a recently developed radiometric data processing technique, are compared with profiles measured simultaneously by conventional techniques. Two years of performance testing of the operational prototype Thermasonde have demonstrated the feasibility of using radiometric remote probing techniques to describe thermal stability conditions within the first 1.5-2.0 km above the surface, during fair weather conditions. Preliminary tests indicate that temperature profiles derived from the Thermasonde can provide useful information, particularly for air pollution meteorology, for describing dispersion characteristics within the planetary boundary layer. The evaluation of a preliminary data reduction technique is described.

(Author)

A72-27819 Quality and applications of aerospace imagery. R. Welch (Georgia, University, Athens, Ga.). *Photogrammetric Engineering*, vol. 38, Apr. 1972, p. 379-398. 46 refs.

Comparisons of the performance capabilities of photogrammetric camera systems with those of other reconnaissance and multispectral camera systems considered for aerospace photography are discussed in the light of laboratory and aerial photograph measurements and theoretical evaluations of factors influencing image quality. It is estimated that photogrammetric cameras in combination with high-quality reconnaissance films will provide high-altitude aerial photography with image qualities comparable to those obtained with reconnaissance and multispectral systems. Planned Skylab experiments will provide multispectral and high-resolution photographs useful for both resource studies and photomapping; the inclusion of a metric camera in Skylab, it is pointed out, would greatly aid cartography.

M.V.E.

A72-30464 # Results of spectrophotometry of natural features from the Soyuz 9 manned spacecraft (Nekotorye rezul'taty spektrofotometrirovaniia prirodnykh obrazovaniy s pilotiruемого kosmicheskogo korablia 'Soyuz-9'). K. Ia. Kondrat'ev, A. A. Buznikov, O. B. Vasil'ev, B. V. Vinogradov, V. M. Orlov, V. I.

Sevast'ianov, and O. I. Smoktii. *Kosmicheskie Issledovaniia*, vol. 10, Mar.-Apr. 1972, p. 245-254. 11 refs. In Russian.

Spectrograms obtained with the manual RSS-2 spectrograph from a manned spacecraft are analyzed and compared with conventional spectrograms. The spacecraft spectrograms are found to be suitable for identifying underlying surfaces and for studying their characteristics from reflection spectra.

V.P.

A72-31241 # Radiation measurements of the thermal infrared in earth resources and meteorology. D. Lorenz (Meteorologisches Observatorium, Hohenpeissenberg, West Germany). In: Space activity in the field of ecology and earth resources; International Convention on Space, 12th, Rome, Italy, March 23-25, 1972, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1972, p. 253, 255-265. 6 refs.

Review of the potentialities and limitations of thermal infrared imaging and radiation measurements in meteorology and earth resources survey applications. Differences in the information content of thermal-infrared and common-photography images are outlined, and infrared line scanners and radiation thermometers are described. The thermal radiation of ground and water surfaces is reviewed, along with specific examples of applications.

M.V.E.

A72-32026 Electro-Optical Systems Design Conference, New York, N.Y., September 14-16, 1971, Proceedings. Conference sponsored by the Laser Industry Association and Society of Photo-Optical Instrumentation Engineers. Chicago, Industrial and Scientific Conference Management, Inc., 1971. 376 p. \$22.50.

Advances in electrooptical systems are reported in papers dealing with new devices and techniques in materials processing, aviation, information display, environmental monitoring, guidance, communication, and pattern recognition applications. Topics considered include new solid-state laser host materials, improved photoelectric detection devices, wideband laser recording systems, holographic storage, aircraft head-up displays and simulators, remote sensing devices and pollution monitoring systems, mail-sorter readers, and reading machines for the newspaper industry.

T.M.

A72-32049 Application of remote sensing to earth resources. W. Frost (Tennessee, University, Tullahoma, Tenn.). In: Electro-Optical Systems Design Conference, New York, N.Y., September 14-16, 1971, Proceedings. Chicago, Industrial and Scientific Conference Management, Inc., 1971, p. 217-224. 17 refs.

The major aspects of satellite earth resources sensing are discussed with the emphasis on the informational needs of users in agriculture, forestry, oceanography, hydrology, geology, and geography. The visible, IR and microwave regions, and some specific applications, such as plant disease detection and salinity distribution evaluation, are covered.

V.Z.

A72-33626 International Aerospace Instrumentation Symposium, 7th, Cranfield Institute of Technology, Cranfield, Beds., England, March 20-23, 1972, Proceedings. Symposium sponsored by the Cranfield Institute of Technology, Royal Aeronautical Society, Institute of Measurement and Control, and Instrument Society of America. Stevenage, Herts., England, Peter Peregrinus, Ltd., 1972. 292 p.

Several new types of instrumentation are described in applications involving correlation interferometry and spectroscopy for aerospace monitoring of earth resources and pollution, ground truth instrumentation for water pollution monitoring, a radiometer for outside air temperature, and the use of airborne Doppler equipment in monitoring windfields for airborne insects. The performance of shock transducers is evaluated, and an electrostatic feedback transducer is described for measuring very low differential pressures. Some topics pertinent to technological training are technician

education, selection and training of the instrumentation engineer, problems in teaching transducer technology, and the teaching of transient phenomena using the Heaviside operational calculus.

D.F.L.

A72-33630 Applications of correlation interferometry and spectroscopy to aerospace monitoring of earth resources and pollution. A. R. Barringer and J. H. Davies (Barringer Research, Ltd., Rexdale, Ontario, Canada). In: International Aerospace Instrumentation Symposium, 7th, Cranfield, Beds., England, March 20-23, 1972, Proceedings. Stevenage, Herts., England, Peter Peregrinus, Ltd., 1972, p. 6.1-6.12. 12 refs.

The techniques of correlation spectroscopy and interferometry make use of the distinctive spectral signatures of gases and vapors in which the incoming spectral signature or its Fourier transform is continuously cross-correlated against a replica stored within the instrument. If suitable background radiation is available the technique gives complete remote sensing capabilities. The use of ground reflected solar radiation or the earth's thermal IR radiation enables these techniques to be applied from aerospace platforms to earth resource and air pollution measurements and examples of such measurements are described. (Author)

A72-33634 Radar imaging applications - Past, present and future. R. K. Moore (Kansas, University, Lawrence, Kan.). In: International Aerospace Instrumentation Symposium, 7th, Cranfield, Beds., England, March 20-23, 1972, Proceedings. Stevenage, Herts., England, Peter Peregrinus, Ltd., 1972, p. 15.1-15.12. 22 refs.

Applications of radar imaging systems in cartography, geography, hydrology, bio-geography, agriculture, oceanography and geography are reviewed. It is pointed out that few of the applications have really been proven completely but that the applications to geology and to cloudy environments have been demonstrated. It is believed that radar will become the primary remote sensor for time-dependent features such as vegetation because of the involved cloud problem which handicaps optical and IR sensors. V.Z.

A72-33635 The civil application of infra-red scanning techniques using an airborne external instrumentation pod. G. L. Lamers (Nationaal Luchtvaartlaboratorium, Amsterdam, Netherlands). In: International Aerospace Instrumentation Symposium, 7th, Cranfield, Beds., England, March 20-23, 1972, Proceedings. Stevenage, Herts., England, Peter Peregrinus, Ltd., 1972, p. 16.1-16.10.

At the National Aerospace Laboratory (NLR), instrumentation pods are used for installing test equipment on aircraft. The reasons for using such an installation are discussed. Under contract with a governmental working group, NLR conducts flight trials with a pod containing an infrared scanner and the associated test equipment. A description of the aircraft installation is given, and some operational experience is discussed. Some results of infrared surveys of water and land surfaces for different purposes are presented. (Author)

A72-34103 Multiband cameras. P. N. Slater (Arizona, University, Tucson, Ariz.). (American Society of Photogrammetry, Annual Fall Convention, San Francisco, Calif., Sept. 7-11, 1971.) *Photogrammetric Engineering*, vol. 38, June 1972, p. 543-555. 10 refs.

The requirements and tolerances for multiband cameras are related to their general geometric and spectroradiometric properties. The SO65 camera used on Apollo 9, an optical multiplexing camera, the S190 camera for Skylab, and the return-beam-vidicon camera for the Earth Resources Technology Satellite are compared. The use of an intensifier-vidicon storage tube system, a dispersing element and vidicon, an image dissector, and solid state arrays in four novel multiband cameras are described. (Author)

A72-34104 Effect of angles on reflectivity. D. D. Egbert and F. T. Ulaby (Kansas, University, Lawrence, Kan.). *Photogram-*

metric Engineering, vol. 38, June 1972, p. 556-564. 10 refs. Grant No. DAAK02-68-C-0089. Project THEMIS.

Discussion of a pretest technique for determining the optimum filter combinations in planning remote multiband-photography sensing missions in the visible and near IR regions. The technique provides multispectral reflectivity curves for targets, terrain features and the background. It involves the determination of spectral reflectance as a function of solar altitude, visual incidence angle and reflected light azimuth angle. It is shown that this angular dependence of reflectivity can be effectively used in target detection. The contrast ratio for a target (asphalt)-background (grass) pair is found to range from 2:1 to 0.5:1 under different angle conditions. V.Z.

A72-34398 Position determination and data acquisition - Eleven areas of related operations (Localisation - Collecte de données: Onze domaines d'activités concernés). M. Jacquemin (Centre National d'Etudes Spatiales, Paris, France) and D. Bayard. *La Recherche Spatiale*, vol. 11, Mar.-Apr. 1972, p. 3-10. In French.

The use of satellites in position determination and data acquisition systems has several applications in the areas of the earth sciences and industry. Some of these are in geodesy and cartography, glaciology and polar expeditions, meteorological atmospheric studies, and aerial and maritime navigation. Other applications are found in the analysis of cosmic phenomena and eruptive gases of volcanoes, the study of migratory patterns of wild animals, and in the observation of atmospheric pollution. Industrial applications include mining and petroleum research, and an application to agriculture can be found in the employment of communication satellite systems by bio-climatological stations. D.F.L.

A72-35381 Using tunable lasers. H. R. Schlossberg (USAF, Optical Physics Laboratory, Bedford, Mass.) and P. L. Kelley (MIT, Lexington, Mass.). *Physics Today*, vol. 25, July 1972, p. 38-42, 44. 28 refs. USAF-sponsored research.

The operating principles and properties of several tunable laser sources are reviewed. In dye lasers, the very broad bandwidth is narrowed, and thus made tunable, through the use of highly frequency-selective optical resonators. Lasers made from dyes such as oxazole, xanthene, and anthracene feature an output from 1.2 to 0.34 microns in the pulsed mode and linewidths as narrow as 35 MHz. Fine tuning of recombination-radiation semiconductor lasers is accomplished by pressure, temperature, and magnetic field variations of the index of refraction, and thus the cavity-mode frequency. The spin-flip Raman laser uses a fixed-frequency laser to pump a semiconductor crystal in a magnetic field. Other nonlinear optical device concepts include optical mixing and optical parametric oscillation. These rely on the properties of a nonlinear crystal. All the tunable lasers have narrow bandwidths, spatial coherence of the tunable output, and high power per unit spectral interval. Some applications of rapid high-resolution laser absorption spectroscopy include air pollution monitoring and automobile-exhaust analysis. D.F.L.

A72-36301 Scanning the spectrum; Proceedings of the Tenth Annual Region 3 Convention, University of Tennessee, Knoxville, Tenn., April 10-12, 1972. Convention sponsored by the Institute of Electrical and Electronics Engineers, Knoxville Utilities Board, and University of Tennessee. New York, Institute of Electrical and Electronics Engineers, Inc., 1972. 552 p.

Topics discussed include future problems and solutions in power generation; digital computer software; theory and application in digital signal processing; electronic circuits; digital computer hardware; electromagnetics; biomedical engineering; control theory and application; digital simulation; communications; power system analysis; remote sensing of the environment; solid-state electronics; control system theory, modeling, and applications; antennas; advanced power generation techniques; information theory; pattern recognition; digital control systems; minicomputer technology; applications of engineering technology; laser and plasma theory; and signal conditioning.

A.B.K.

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A72-36697 The accuracy of the intermittent photographic film advance in the camera of an airborne thermal scanner. E. Ia. Karizhenskii, A. M. Shirobokov, and L. A. Levina. (*Optiko-Mekhanicheskaya Promyshlennost'*, vol. 38, Dec. 1971.) *Soviet Journal of Optical Technology*, vol. 38, Dec. 1971, p. 719-721. Translation.

This paper discusses the use of an electromechanical stepping mechanism, providing intermittent advance of the photographic film, in the camera of an airborne thermal scanner designed for geological mapping and forest fire detection. The accuracy of this system is discussed. (Author)

A72-37251 International Microwave Symposium, Arlington Heights, Ill., May 22-24, 1972, Proceedings. Conference sponsored by the Institute of Electrical and Electronics Engineers. Edited by E. G. Book. New York, Institute of Electrical and Electronics Engineers, Inc., 1972. 274 p. \$20.

Scattering parameter measurement techniques in microstrip, S-band radiometer design for high absolute precision measurement, and measurement of RF antenna near field patterns using liquid crystal sensors are among the topics covered in papers concerned with microwave technology. Other topics covered include high power microstrip RF switches, high burnout gallium arsenide Schottky barrier diodes, and scattering from a large hole of any shape in a multimode waveguide.

M.V.E.

A72-37252 S-band radiometer design for high absolute precision measurement. A. W. Love (North American Rockwell Corp., Space Div., Downey, Calif.) and W. N. Hardy (British Columbia, University, Vancouver, Canada). In: International Microwave Symposium, Arlington Heights, Ill., May 22-24, 1972, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 5-7.

Description of a radiometer for the remote measurement of absolute sea surface temperature. The concept underlying the design of an instrument capable of an absolute precision of a few tenths degrees Kelvin in the measurement of brightness temperature at S-band is described. The role of the antenna is discussed and the importance of high ohmic and beam efficiencies is stressed. Finally, a description of the hardware itself is presented, along with the development of a unique cryogenically cooled termination used to calibrate the entire system, including antenna. (Author)

A72-37481 # A proposal for a radar device with two simultaneously emitted radar frequencies which has a reduced susceptibility to disturbances produced by sea echoes (Ein Vorschlag für ein Radargerät mit verminderter Störanfälligkeit gegen Seegangechos unter Benutzung zweier gleichzeitig ausgesendeter Radarfrequenzen). K.-D. Schwarz. Hannover, Technische Universität, Fakultät für Maschinenwesen, Dr.-Ing. Dissertation, 1971. 175 p. 52 refs. In German.

The known characteristics of sea echoes are examined in connection with an attempt to interpret these characteristics on the basis of model concepts. The possibility of a selective suppression of the echoes is investigated with the aid of the considerations of system theory. It is found that in most cases the expense involved in approaches for the complete suppression of such echoes is intolerably great. Measurements were conducted to investigate the behavior of the surface of the sea in the case of the simultaneous presence of two signals of different frequency or polarization. The concept of a two-frequency radar is discussed. Such a device would make possible an increase in operational safety together with a pronounced reduction in the radar sensitivity to sea echo effects. G.R.

A72-37576 Vidicon system uses three TV sensors. K. J. Stein. *Aviation Week and Space Technology*, vol. 97, July 31, 1972, p. 53, 56, 57.

Description of the advanced 2-in. return beam vidicon (RBV) camera system aboard the Earth Resources Technology Satellite (ERTS), which employs three high-resolution television sensors coaligned to view the identical scene in three different spectral bands. The system photographs simultaneously in the blue-green, red, and near-IR regions, producing pictures with resolution of 4,000 TV lines. The three images, after transmission to ground stations, may be studied separately or combined into a single detailed color picture. The cameras are mounted on a baseplate that serves as a prealignment reference plane and thermal control element. Light falling on the target changes resistance of the surface, changing the energy in the return electron beam. The ERTS tape recorder uses a transverse scan technique to achieve head-to-tape speed of 2000 in./sec. F.R.L.

A72-37601 Engineering applications of holography; Proceedings of the Symposium, Los Angeles, Calif., February 16, 17, 1972. Symposium sponsored by the Advanced Research Project Agency. Redondo Beach, Calif.; Society of Photo-optical Instrumentation Engineers, 1972. 376 p. Members, \$15.; nonmembers, \$23.

Recent developments in the practical use of holography to obtain quantitative engineering data are described in papers dealing with wave propagation phenomena, stress analysis of structures, material characterization, front surface blow-off, fragmentation and fracture, flow visualization, nondestructive testing and gauging, computer generated holograms, and training aids. Specific topics examined include microwave hologram radar imagery, evaluation of airfoils by contouring, holographic applications in photogrammetry and mapping, analysis of structural vibration patterns, synthetic aperture ultrasonic imagery, fabrication of metallic gratings, and in-line holography of reacting liquid sprays.

T.M.

A72-43551 Geostationary environmental satellites. J. G. Vaeth (NOAA, National Environmental Satellite Service, Washington, D.C.). *Spaceflight*, vol. 14, Oct. 1972, p. 370-374.

A NASA-developed satellite, which is scheduled for launch in 1973, will provide a continuous view of the weather and other environmental factors over the contiguous United States. Roughly one-quarter or more of the weight in orbit of this 500 lb. class spacecraft will be taken up by its prime environmental sensor, the Visible Infrared Spin Scan Radiometer (VISSR). This instrument will image the earth both day and night. The VISSR contains a telescope with 16-in. optics. Aspects of ground station equipment are discussed together with the antenna system and the data collection service.

G.R.

A72-43879 * # Performance of S-192 /Hg,Cd/Te arrays. N. C. Aldrich and J. D. Beck (Honeywell Radiation Center, Lexington, Mass.). *Applied Optics*, vol. 11, Oct. 1972, p. 2153-2156. Contract No. NAS9-11196.

Very high performance (Hg,Cd)Te photoconductive detectors have been fabricated for use on the S-192 experiment, which is a multispectral scanner being built by Honeywell for the NASA Manned Space Center's Skylab. The S-192 will scan the earth from Skylab and record data in twelve near infrared spectral bands and one long wavelength band. These detectors demonstrate good uniformity in performance across an array. State-of-the-art fabrication techniques have been used to make detectors with good definition that are 5-10 microns thick with 25-micron spacing between elements. (Author)

A72-43882 Nimbus limb radiometer, Apollo fine sun sensor, and Skylab multispectral scanner. J. C. Kollodge, R. A. Weagant (Honeywell Radiation Center, Lexington, Mass.), and J. R. Thomas (Honeywell, Inc., Aerospace Div., St. Petersburg, Fla.). *Applied Optics*, vol. 11, Oct. 1972, p. 2169-2176.

Examples of three different types of electrooptical systems developed by the Honeywell Radiation Center for NASA are described. One is a multichannel infrared radiometer that will permit temperature and constituent inferences over the globe; it carries a one-year supply of cryogenics for the trimetal infrared detectors. The

second is the Apollo telescope mount fine sun sensor, a tracking device making use of solar radiation and the transmission near critical angle of refraction, that will track within plus or minus 2 sec of arc to a designated point on the sun. The final example is the Skylab S-192 multispectral mapper for a variety of earth resources applications. (Author)

A72-44393 # Some applications of infrared radiation detectors in the 5- to 30-micron range (Niektóre zastosowania detektorów promieniowania podczerwonego zakresu 5-30 microns). R. Jezykowski and T. Persak (Wojskowa Akademia Techniczna, Warsaw, Poland). (*Polska Akademia Nauk, Ogólnokrajowa Konferencja o Polprzewodnikowych Detektorach Promieniowania, Warsaw, Poland, Feb. 7, 8, 1972.*) *Postępy Fizyki*, vol. 23, no. 4, 1972, p. 399-416. 31 refs. In Polish.

Description of the technical specifications and some structural details of IR (5 to 30 microns) detectors used in industrial, scientific, and military applications. Examples of measurements and instrumentation are described for uses in mining, the petroleum industry, forestry, agriculture, metallurgy, transportation, light industry, meteorology, astronomy, geophysics, medicine, communications, rocketry, and military reconnaissance. T.M.

A72-45107 # Remote sensing of earth resources by microwave radiometry. E. Schanda (Bern, Universität, Berne, Switzerland). *Industries Atomiques et Spatiales*, vol. 16, July-Aug. 1972, p. 65-80. 20 refs.

The basic properties of microwave radiometers are discussed, and two specific designs of imaging radiometers are explained briefly. Thermal images of urban sceneries recorded at 3-cm and 3-mm wavelengths are presented to show the potentialities of this technique. The effect of the atmosphere is described briefly, and several present and future applications for the remote sensing of earth resources and of the state of the soil are mentioned. (Author)

A72-45182 * # High resolution multispectral camera system for ERTS A & B. B. P. Miller, G. A. Beck, and J. M. Barletta (RCA, Astro-Electronics Div., Princeton, N.J.). *International Astronautical Federation, International Astronautical Congress, 23rd, Vienna, Austria, Oct. 8-15, 1972, Paper. 11 p. 8 refs. Contracts No. NAS5-11621; No. NAS5-21904.*

A very-high resolution multispectral television camera system is being developed for use on the earth resources technology satellite (ERTS) program. There are three cameras in the system, each viewing the same area but operating in the blue-green, red, and near-infrared spectral bands. In the laboratory the cameras' limiting resolution is 4500 TV lines over the 25 x 25-mm image format of the return beam vidicon (RBV). A model was developed to predict the resolving power performance of the RBV camera under realistic conditions. To verify the model, tests were conducted using the RBV camera, a laser-beam image reproducer and a series of AF tribar test patterns of known values of contrast. As a more graphic demonstration, simulated multispectral images were generated using color-IR photographs from Apollo 9. The measured signal-to-noise, resolution, and spectral characteristics of the ERTS Flight A and Flight B three-camera systems are presented in conclusion. (Author)

A72-46229 # Balloon nacelle for terrain photography from very high altitudes (Nacelle ballon pour photographie du sol à très haute altitude). L. Salter (Société Européenne de Propulsion, Vernon, Eure, France). *International Astronautical Federation, International Astronautical Congress, 23rd, Vienna, Austria, Oct. 8-15, 1972, Paper. 21 p.* In English and French.

Description of a set of aerial photography equipment developed in France as the payload or nacelle for high-altitude photography balloons used in earth-resources inventorying activities. The nacelle consists of a rigid circular base carrying the whole equipment in an insulated, shockproof housing. The equipment assembly is roll-

stabilized by means of an inertial wheel and is suspended in a damping system of flexible structure for protecting the nacelle on its return by parachute to the ground. The standard equipment includes the capabilities of 70 mm film photography at a rate adjustable in flight by remote control, with a ground area coverage of 625 sq km per frame and 6000 sq km in a three hour flight. The scale is 1 to 450,000 and the resolution close to 10 m. The usability of several different combinations of kinds and sizes of films and focal lengths of lenses provides considerable variability of the system's capabilities. M.V.E.

A73-10139 Patterns from Apollo VI photos. R. K. Holtz and R. E. Boyer (Texas, University, Austin, Tex.). *Photogrammetric Engineering*, vol. 38, Oct. 1972, p. 974-984. 26 refs.

Interdisciplinary study of Apollo VI photographs of the Dallas-Fort Worth area demonstrated their applicability to a variety of urban concerns. The geology, hydrology, land use, and transportation net of this area were established from the photographs and were compared with known ground-based data. Close correlations indicate the potential usefulness of the Earth Resources Technology Satellite successfully launched in July 1972. The sequential multispectral imagery to be obtained will enable careful monitoring of many aspects of city growth. This research also demonstrates that the study of specific features will be enhanced through the use of camera and/or projection filters. Such features may include areas of recent growth or reconstruction within the city, bedrock types with certain moisture-holding capabilities, and sediment patterns in streams and reservoirs. (Author)

A73-10351 Conference on Atmospheric Radiation, Fort Collins, Colo., August 7-9, 1972, Preprints. Conference sponsored by the American Meteorological Society. Boston, American Meteorological Society, 1972. 322 p. Members, \$15; nonmembers, \$20.

Theoretical and observational results are discussed which are intended to lead to better understanding of radiation processes and effects. Radiative transfer in realistic atmospheres, radiative properties of atmospheric constituents, instrumentation and measurements, the radiative energy budget, and radiation interaction in fluid dynamic systems are considered. F.R.L.

A73-10377 # Simultaneous measurements of solar radiation from aircraft and satellites during BOMEX. T. H. Vonder Haar and S. K. Cox (Colorado State University, Fort Collins, Colo.). In: Conference on Atmospheric Radiation, Fort Collins, Colo., August 7-9, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 128-133. 14 refs. NSF Grant No. GA-018783.

Data obtained in a specially coordinated program, using research aircraft and the ATS-3 geostationary satellite, are presented on the net atmospheric solar radiation absorption for cloudfree and single-cloud-layer cases. In addition, a brief discussion of measured transmittance, cirrus reflectance, and absorptance characteristics is included. M.V.E.

A73-10384 * # Elimination of cloud effects in sensing ozone from 9.6 micron band. C. Prabhakara, B. J. Conrath, R. A. Hanel, and V. G. Kunde (NASA, Goddard Space Flight Center, Greenbelt, Md.). In: Conference on Atmospheric Radiation, Fort Collins, Colo., August 7-9, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 169-172. 6 refs.

Description of an objective method for extracting the spectral information from the 9.6 micron region pertaining to atmospheric ozone. This method has been developed by examining a large number of Nimbus 4 infrared interferometer-spectrometer spectra. The method is capable of eliminating, not only the effects of clouds, but also those of interference from the reststrahlen bands of desert sands. M.V.E.

A73-10385 * # The effect of solar radiation reflected from water surfaces on airborne and surface measurements in the thermal

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infrared. V. S. Whitehead (NASA, Manned Spacecraft Center, Houston, Tex.). In: Conference on Atmospheric Radiation, Fort Collins, Colo., August 7-9, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 173-177.

A73-11161 * Some new satellite sensors and applications. L. Steg (GE Space Sciences Laboratory, Philadelphia, Pa.). In: International Symposium on Space Technology and Science, 9th, Tokyo, Japan, May 17-22, 1971, Proceedings. Tokyo, AGNE Publishing, Inc., 1971, p. 623-634. Research supported by the University of California; Contracts No. NAS1-10139; No. NAS8-24683; No. NAS8-26157.

It would appear that over the next few years general diagnostic space exploration by satellite-borne conventional sensors will be well on its way under the sponsorship of many nations. It is the objective of this paper to review two new sensor developments and an application program. The first sensor (the photopolarimeter) makes use of polarized light to determine unique signatures ranging from aerosols to signatures for surface moisture. The second sensor (the correlation interferometer) makes use of absorption spectroscopy to detect anomalous gas concentrations and will be used to explore the CO sink problem, significant in pollution. In the applications area, some demonstration experiments in the general area of space processing, scheduled for the remaining Apollo flights, are described. If successful, these experiments will give some indication of typical products which could be produced cost effectively in space. (Author)

A73-12267 # Observations of precipitation zones from satellites using microwave radiometers. A. G. Gorelik, V. V. Kalashnikov, and Iu. A. Frolov (Akademii Nauk SSSR, Moscow, USSR). In: Space research XII; Proceedings of the Fourteenth Plenary Meeting, Seattle, Wash., June 18-July 2, 1971. Volume 1. Berlin, East Germany, Akademie-Verlag GmbH, 1972, p. 503-508. 10 refs.

Ground-based microwave radiometer measurements have been used to obtain the radiation temperatures of clear atmosphere, clouds and precipitation. As a result, temperature contrasts were calculated for various meteorological objects over ocean, dry and wet ground when looking from space at 0.4-1.6 cm wavelengths. Calculations of horizontal and vertical polarization were carried out for a wide range of observational angles. Numerical data are compared with aircraft and satellite observations. Application of satellite-borne microwave radiometers for determination of precipitation zones under various conditions of cloudiness is discussed.

(Author)

A73-12268 # Precipitation detection over the ocean using microwave satellite radiometry. F. R. Cayla (Bureau d'Etudes Météorologiques Spatiales, Paris, France). In: Space research XII; Proceedings of the Fourteenth Plenary Meeting, Seattle, Wash., June 18-July 2, 1971. Volume 1. Berlin, East Germany, Akademie-Verlag GmbH, 1972, p. 509, 510.

A73-12339 # The capabilities of the spin-scan imaging technique. T. Gehrels (Arizona, University, Tucson, Ariz.), V. E. Suomi, and R. J. Krauss (Wisconsin, University, Madison, Wis.). In: Space research XII; Proceedings of the Fourteenth Plenary Meeting, Seattle, Wash., June 18-July 2, 1971. Volume 2. Berlin, East Germany, Akademie-Verlag GmbH, 1972, p. 1765-1769.

Description of spin-scanning devices used or to be used on various space missions, and review of their merits as compared to those of television. The devices reviewed include the monochromatic spin-scan imaging camera on ATS 1, the multicolor spin-scan cloud camera on the ATS 3 satellite, the visible infrared spin-scan radiometer to be flown on the synchronous meteorological satellite the multispectral scanner being built for the ERTS satellite, and the imaging photopolarimeter experiment on Pioneer F and G as the only line-scan imager now being applied to other-than-earth oriented missions. M.V.E.

A73-14476 Annual Allerton Conference on Circuit and System Theory, 9th, Monticello, Ill., October 6-8, 1971, Proceedings. Conference sponsored by the University of Illinois. Urbana, University of Illinois, 1972. 1242 p. \$10.00.

The topics considered are in the fields of optimal control, estimation and filtering, computer organization, active and nonlinear circuits, system order reduction, automata and sequential machines, optimization methods, systems modeling and simulation, advances in communications, and transportation systems. Aspects of control systems design are discussed together with network theory, coding theory, stability theory, digital filters, economic systems, linear system theory, and differential games. Other areas explored include environmental remote sensing, parallel processing computers, signal processing in communications, and distributed networks.

G.R.

A73-14487 # Tools for remote sensing experiments. G. Nagy (IBM Thomas J. Watson Research Center, Yorktown Heights, N.Y.). In: Annual Allerton Conference on Circuit and System Theory, 9th, Monticello, Ill., October 6-8, 1971, Proceedings. Urbana, University of Illinois, 1972, p. 987-996. 29 refs.

The requirements for digital processing of Earth Resources Technology Satellite and Skylab imagery are described in terms of the experience gained with Gemini and Apollo photographs, televised weather satellite pictures, and airborne multispectral recordings. The topics discussed include format and statistical peculiarities of these data sets, analog-to-digital conversion and playback devices, image registration, linear and projective transformations, distortion correction, cloud detection, entry of ground-truth information, and the evaluation of classification results. (Author)

A73-14564 Some results of spectrophotometry of natural formations from the manned spaceship Soyuz-9. K. Ia. Kondrat'ev, A. A. Buznikov, O. B. Vasil'ev, B. V. Vinogradov, V. M. Orlov, V. I. Sevast'ianov, and O. I. Smoktii. (*Kosmicheskie Issledovaniia*, vol. 10, Mar.-Apr. 1972, p. 245-254.) *Cosmic Research*, vol. 10, no. 2, Nov. 1972, p. 218-226. 11 refs. Translation.

Spectrograms obtained with the manual RSS-2 spectrograph from a manned spacecraft are analyzed and compared with conventional spectrograms. The spacecraft spectrograms are found to be suitable for identifying underlying surfaces and for studying their characteristics from reflection spectra. V.P.

A73-14805 Accuracy of satellite radar altimeter measurements. A. H. Greene (Raytheon Co., Wayland, Mass.). In: The use of artificial satellites for geodesy; Proceedings of the Third International Symposium, Washington, D.C., April 15-17, 1971. Washington, D.C., American Geophysical Union, 1972, p. 227-237. 9 refs.

A Ku-band pulsed radar altimeter installed in a satellite can be used to measure instantaneous satellite altitude above the surface of the ocean to high accuracy. Major sources of measurement error can be grouped as follows: radar altimeter, propagation, and ocean surface and geometry. Each group contains random and bias errors. These are discussed and evaluated, the major emphasis being on residual errors that accrue from physical phenomena not under the control of the altimeter designer or user. (Author)

A73-15463 * Earth resources sensing technology - 24-channel multispectral sensor system development. J. E. Kessel (NASA, Manned Spacecraft Center, Houston, Tex.). In: NTC '72; National Telecommunications Conference, Houston, Tex., December 4-6, 1972, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 40A-1 to 40A-5.

Description of the technology applied to a 24-channel multispectral scanner developed as a tool to investigate the portion of the electromagnetic spectrum between 0.34 and 13.0 microns. Energy reflected or emitted from the terrain and system calibration sources is collected by the scan mirror, reflected into the collecting optics, and brought to focus in a plane containing a square aperture. A

dichroic optical element splits the energy which passes through the aperture into two wavelength bands in which wavelengths are greater than and less than 2.0 microns, respectively. These two wavelength bands are dispersed spectrally by two grating spectrometers. The energy from 24 distinct spectral intervals is transformed into electrical signals by 24 detector/preamplifier combinations. These signals then become the inputs to a video processor in an airborne electronics console. A.B.K.

A73-15766 Remote sensing of earth resources and the environment; Proceedings of the Seminar-in-Depth, Palo Alto, Calif., November 8, 9, 1971. Seminar sponsored by the Society of Photo-optical Instrumentation Engineers, American Meteorological Society, and NOAA. Edited by Y. H. Katz. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers (SPIE Seminar Proceedings. Volume 27), 1972. 150 p. Members, \$15.; nonmembers, \$24.

Papers concerning recent developments in environment and earth-resource remote sensing techniques are given. The topics include laser radar applications in atmospheric studies; multiband camera photography; the use of the Planck law in remote sensing; satellite data applications in hydrology; satellite and spacecraft applications in wind measurements and ocean color measurements; a solid state multispectral imager; and radiometric techniques. V.Z.

A73-15767 Progress report on the remote detection of CAT by infrared. R. W. Astheimer (Barnes Engineering Co., Stamford, Conn.). In: Remote sensing of earth resources and the environment; Proceedings of the Seminar-in-Depth, Palo Alto, Calif., November 8, 9, 1971. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1972, p. 1-8. 8 refs.

Survey of the results of flight tests designed to evaluate IR instrumentation that scans atmospheric temperature profiles for the purpose of detecting clear air turbulence in the flight path. Initial equipment that scanned the horizontal temperature profile provided an excessively high false alarm rate, and a vertical scan mode was added to obtain information on the vertical temperature structure. Flight results show that the radiometric signal responds to the vertical temperature structure of the atmosphere in accordance with theoretical expectations. It is expected that the additional information will help to reduce the false alarm rate. T.M.

A73-15768 Large laser radar for atmospheric probing. H. W. Halsey (GE Space Sciences Laboratory, Philadelphia, Pa.). In: Remote sensing of earth resources and the environment; Proceedings of the Seminar-in-Depth, Palo Alto, Calif., November 8, 9, 1971. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1972, p. 9-15.

Description of the tracking mount, optics, electronic signal processing equipment, and display features of a 1-J ruby laser system used for detection and recording of atmospheric scattering data. The operation of the laser system can be set up for any two wavelengths which have sufficient separation for available narrow-bandwidth interference filters to be used. The two color capabilities of the system are used to obtain data on the differences between Rayleigh and Mie scattering which exhibit different scattering functions at different wavelengths. T.M.

A73-15769 Tunable dye lidar techniques for measurement of atmospheric constituents. R. D. Hake, Jr., E. K. Proctor, and R. A. Long (Stanford Research Institute, Menlo Park, Calif.). In: Remote sensing of earth resources and the environment; Proceedings of the Seminar-in-Depth, Palo Alto, Calif., November 8, 9, 1971. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1972, p. 17-24.

A tunable-wavelength lidar system has been constructed for remote probing of various species in the lower and upper atmo-

sphere. The system consists of a flashlamp-pumped dye laser, a 16-in. Schmidt receiver, and a high-speed data-handling system. The laser is capable of delivering 0.5-J pulses with a linewidth of 0.02 Å at a rate of 0.25 Hz. Pulse rates up to 1 Hz have been achieved with a somewhat larger linewidth. (Author)

A73-15770 A review of recent developments in multiband cameras. P. N. Slater (Arizona, University, Tucson, Ariz.). In: Remote sensing of earth resources and the environment; Proceedings of the Seminar-in-Depth, Palo Alto, Calif., November 8, 9, 1971. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1972, p. 25-32. 9 refs.

A number of recent developments in multiband cameras are discussed. In particular, descriptions are given of the SO65 camera used on Apollo 9, an optical multiplexing camera, the S190 camera for Skylab, and the return-beam-vidicon camera for the Earth Resources Technology Satellite. Also described are the use of an intensifier-vidicon storage tube system, a dispersing element and vidicon, an image dissector, and solid state arrays in four novel multiband cameras. The role of film and electro-optical multiband cameras in future space missions is discussed. (Author)

A73-15771 * An electronic multiband camera film viewer. L. H. Roberts (International Imaging Systems, Mountain View, Calif.). In: Remote sensing of earth resources and the environment; Proceedings of the Seminar-in-Depth, Palo Alto, Calif., November 8, 9, 1971. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1972, p. 33-36. Contract No. NAS9-11028.

An electronic viewer for real-time viewing and processing of multiband camera imagery is described. The Multiband Camera Film Viewer (MCFV) is a high-resolution, 1000-line system scanning three channels of multiband imagery. The MCFV provides a calibrated output from each of the three channels for viewing in composite true color, analog false-color, and digitized, enhanced false color. (Author)

A73-15773 Use of the Planck law in remote sensing. C. E. Campbell (Lockheed Electronics Co., Inc., Houston, Tex.). In: Remote sensing of earth resources and the environment; Proceedings of the Seminar-in-Depth, Palo Alto, Calif., November 8, 9, 1971. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1972, p. 49-55. 6 refs.

Ways are described to minimize errors when the Planck law is used for single- and two-color temperature measurements. Various approximations useful in remote sensing are discussed, as well as a suggested method for measuring temperature and emissivity simultaneously with active and passive systems at each of two wavelengths. Measurements at multiple wavelengths are also presented in this mathematical discussion. (Author)

A73-15780 * Optical design of an imaging spectral radiometer for earth resources applications. T. I. Harris (Optical Research Associates, Pasadena, Calif.), F. Reynard (Perkin-Elmer Corp., Costa Mesa, Calif.), and H. D. Wolpert (TRW Systems Group, Redondo Beach, Calif.). In: Remote sensing of earth resources and the environment; Proceedings of the Seminar-in-Depth, Palo Alto, Calif., November 8, 9, 1971. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1972, p. 117-124. Contract No. NAS9-11146.

Description of the optics, thermal compensation measures, and calibration procedures for a scanning imaging spectroradiometer to be used in earth resources sensing applications. The spectral range covered extends from 4000 to 8500 Å. Two possible modes of operation include (1) a high-spatial-resolution terrestrial survey mode with moderate spectral resolution, and (2) a high-spectral-resolution ocean survey mode with decreased spatial resolution. Two high-aperture f/1.4 objective lenses (providing fields of view of 10 and 25 deg) are interchangeable to give added flexibility in planning experiments with this instrument. A diffraction grating disperses the spectrum which is then scanned by the image sensor. T.M.

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A73-15781 * **A solid state multispectral imager.** A. Green, S. Kennedy, and C. K. Yutkowitz (Fairchild Camera and Instrument Corp., Syoset, N.Y.). In: Remote sensing of earth resources and the environment; Proceedings of the Seminar-in-Depth, Palo Alto, Calif., November 8, 9, 1971. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1972, p. 125-132. Contract No. NAS5-21597.

Photodiode arrays used as image sensors in satellite remote imaging systems offer the advantages of geometric accuracy, precise registration of scene elements, enhanced operational reliability, and wide spectral response. Principles of photodiode-array operation are reviewed, and the latest developments in self-scanned array chip technology are described along with optical system requirements for multispectral coverage. Results of development efforts with a spaceborne solid-state multispectral camera based on linear sensing array technology are outlined to demonstrate the capabilities of this approach to multispectral sensing. T.M.

A73-15783 **An airborne Ka-band microwave radiometric measurement mapping system.** M. C. Hoover and R. P. Moore (U.S. Naval Weapons Center, China Lake, Calif.). In: Remote sensing of earth resources and the environment; Proceedings of the Seminar-in-Depth, Palo Alto, Calif., November 8, 9, 1971. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1972, p. 147-157. Navy-supported research.

Discussion of the design and performance of a small-aperture pod-mounted Ka-band mapping radiometer system with a low-noise wideband parametric amplifier which can be attached to small aircraft for radiometric microwave measurements of terrain. Evidence is obtained that such systems can be effectively used in the millimeter range for navigation and terminal landing systems of aircraft, for environmental sensing, and for location of ships at sea. An advantage of this system is the capability of all-weather around-the-clock passive operation. The radiometer pod, antenna setting, electronic ingredients, and stabilization of the mapping system are described. V.Z.

A73-17126 **Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1.** Conference sponsored by the University of Tennessee. Edited by F. Shahrokhi (Tennessee, University, Tullahoma, Tenn.). Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972. 793 p. \$20.

Recent developments in satellite and airborne remote sensing and imaging systems are described in papers dealing with sensor design features; transmission equipment; data interpretation; and relevant applications in agriculture, urban planning, and scientific research. Systems procedures for incorporating remote sensing data into management processes dealing with the planning of industrial and social development are explained, and typical results of identification studies are reviewed to illustrate experience gained in the correlation of imagery characteristics with specific types of vegetation, land quality, and weather processes. T.M.

A73-17129 **A critique of remote sensing evaluation techniques.** A. S. Benson (California, University, Berkeley, Calif.). In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 52-63.

The objective of this paper is to present that information which the remote sensing researcher must supply to a remote sensing system user in order that the latter can make valid operational decisions. Throughout the entire evaluation process of a system (viz., definition of the objective, ground data collection, statistical design, and analysis and interpretation) the researcher makes assumptions

necessary for his analysis which might effect the validity of the subsequent operational decisions. If the system user is not aware of these assumptions and the impact they will have on the operational validity of the system, the evaluation may be meaningless. (Author)

A73-17130 **Basic principles of earth resource sensors.** G. A. Cato (Celeco Industries, Costa Mesa, Calif.). In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 64-82. 11 refs.

The basic principle of operation of the major sensor types is discussed. The capabilities, advantages and disadvantages of each sensor category are presented to enable the resource scientist to make a preliminary selection of the type that best fits his needs. The atmospheric effects, such as transmission and scattering, physical effects, such as polarization and wave length and data format are explained. The sensors are divided into six operational categories: cameras, radiometers, scanners, spectrometers, radars and field meters and the individual sensors within each category are discussed. (Author)

A73-17131 * **Remote sensing techniques in evaluating earth resources - A study of potential uses of remote sensing for Southeastern U.S.** F. Shahrokhi and J. P. Rhudy (Tennessee, University, Tullahoma, Tenn.). In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 95-132. 33 refs. NASA-supported research.

Review of the results of a recent study of the potential uses of remote sensing in the Southeastern United States in evaluating resources. The use of remote sensing in the evaluation and management of earth resources is discussed, as well as the use of satellites and aircraft as remote sensing platforms. The specific needs to be satisfied by remote sensing in the Southeast region are considered, dwelling, in particular, on the use of remote sensing for land use mapping, forest inventory, water pollution monitoring, strip mine reclamation, air pollution, demonstration farms and forests, and reservoir ecology. A brief description is given of multispectral photographic and scanner data analysis techniques, to illustrate that regional information needs can be met with existing technological capability. A.B.K.

A73-17133 **Synthetic aperture SLAR systems and their application for regional resources analysis.** K. B. Craib (Aero Service Corp., Philadelphia, Pa.). In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 152-178. 15 refs.

Review of the principle of operation of side-looking airborne radar (SLAR), noting the utility of such radar systems in terrain imaging. A comparative study is made of 'real aperture' SLAR systems, or systems with resolution limited by the length of the physical antenna, and so-called 'synthetic aperture' systems, in which the length of the antenna is limited only by the storage capacity of the recording medium in the receiver. With significantly finer resolution available in the synthetic-aperture system, much more information is recorded in the image and more accurate interpretations are possible. Furthermore, since this resolution is achieved independent of distance between transmitter and target, operations at high altitude may be conducted with attendant benefits of wider area coverage and more stable flight conditions. Some experience gained from operation of an X-band synthetic-aperture SLAR system is reviewed. A.B.K.

A73-17140 To the problem of influence of shapes and sizes of the radiating objects on infrared aerial survey. B. V. Shilin, V. S. Kocharov, and S. A. Suppe (Ministry of Geology, Laboratory on Aeromethods, Leningrad, USSR). In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 338-351. 7 refs.

A theoretical analysis is presented on the effects of IR-radiation-source shape and size on aerial IR surveys performed at various flight altitudes. The revealed nature and magnitude of these effects are discussed in terms of some of their practical implications for aerial IR surveys. M.V.E.

A73-17144 * ERTS two-inch RBV cameras performance characteristics. B. P. Miller, G. A. Beck, and J. M. Barletta (RCA, Astro-Electronics Div., Princeton, N.J.). In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 408-437. 7 refs. Contracts No. NAS5-11621; No. NAS5-21904.

A very-high resolution multispectral television camera system is being developed for NASA for use on the ERTS program. There are three cameras in the system, each viewing the same area but operating in the blue-green, red, and near-infrared spectral bands. In the laboratory, the cameras' limiting resolution is 4500 TV lines over the 25x25-mm image format of the return beam vidicon (RBV). Analysis of typical ERTS scenes shows that actual contrast ratios will be much lower than those of laboratory test targets. A model was developed to predict the resolving power performance of the RBV camera under realistic conditions. (Author)

A73-17156 Experience with the cross-beam photometer system. R. A. Morrison (Talladega College, Talladega, Ala.). In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 722-737.

Several experiments have been performed with a crossed-beam visible-light photometer system to determine whether a correlation analysis of the data from such a system can give useful information about atmospheric phenomena. The device employs five photometers spreading in a plane (the fan beams), and a single photometer about 30 meters away on the ground, whose field of view crosses the five fan beams. The system was first used to detect a slightly visible plume near the mouth of a smokestack; analysis of the data gave information about the turbulent flow of the smoke. When the photometers observed clouds moving perpendicular to the plane of the fan, approximate heights and sizes of the visual structures were determined. When the cloud motion was in the plane of the fan, cloud heights and velocities were measured. (Author)

A73-17157 Luminescence signatures induced by lasers with enhanced specificity for remote active sensing. H. G. Gross (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.). In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 738-768. 9 refs. Research supported by the McDonnell Douglas Astronautics Independent Research and Development Funds.

A73-17826 # Electron-proton spectrometer for the GEOS satellite. R. Gunzenhauser. *Dornier-Post* (English Edition), no. 4,

1972, p. 18-21. Research supported by the Max-Planck-Institut für Aeronomie.

The S 321 electron-proton spectrometer is used in one of the nine experiments which are to be conducted with the aid of the GEOS geostationary satellite. The satellite is to be launched by the European Space Research Organization in 1976. The experiments are to provide information regarding the distribution of electrical and magnetic fields and waves, the thermal plasma, and energy particles. The S 321 experiment, in particular, is conducted to study the behavior of particle flows and energy spectra of protons and electrons. The main components of the spectrometer are discussed. G.R.

A73-18276 Annual Electro-Optical Systems Design Conference, 4th, New York, N.Y., September 12-14, 1972, Proceedings of the Technical Program. Conference sponsored by the Laser Institute of America. Chicago, Industrial and Scientific Conference Management, Inc., 1972. 404 p. \$25.

Industrial and medical laser applications are discussed together with topics in the fields of microwave remote sensing, optical signal processing, modulators, and low light level imaging. Other fields considered include atmospheric optics, wide-band photooptical recording techniques, and IR detectors and systems. Electrooptical systems for space are also examined, giving attention to the selection and design of electrooptical instruments for outer planet exploration, Viking ground reconstruction equipment, statistics of aerial imagery, the Uhuru star aspect sensor, and the optically linked missile. G.R.

A73-18285 Clustering phenomena in side-looking radar (SLR) microtexture. E. Y. Kedar and S.-Y. Hsu (New York, State University, Binghamton, N.Y.). In: Annual Electro-Optical Systems Design Conference, 4th, New York, N.Y., September 12-14, 1972, Proceedings of the Technical Program. Chicago, Industrial and Scientific Conference Management, Inc., 1972, p. 95-97. 5 refs.

The SLR imagery statistical surface observation makes it possible to distinguish between terrain features, as for instance between a cornfield and a wheatfield. The reasons for the successful recognition of terrestrial surface features in some cases and the observed misclassification of terrain in others are explored. It is found that slope and valley-side effects are mainly responsible for the misclassifications. In terms of location pattern analysis, these effects distort the distributional pattern of microcells due to the formation of local clusters. G.R.

A73-18438 IR satellite photographs in the earth sciences - A comparison of the IR ranges from 3 to 4 micrometers and from 10 to 12 micrometers (Infrarot-Satellitenaufnahmen in den Geowissenschaften - Zum Vergleich der IR-Bereiche von 3-4 micrometers und 10-12 micrometers). H. Kaminski (Bochum, Sternwarte, Bochum, West Germany). *Bildmessung und Luftbildwesen*, vol. 41, Jan. 1, 1973, p. 21-29. 30 refs. In German.

Investigations conducted with the aid of IR satellite photographs are reviewed. Examples of an interpretation of geothermal phenomena are discussed, taking into account volcanic eruptions and the recognition of temperature differences of the water in coastal areas. Pictures obtained with the very high resolution radiometer of the new weather satellite NOAA-2 (ITOS D) are presented. G.R.

A73-21701 American Society of Photogrammetry and American Congress of Surveying and Mapping, Fall Convention, Columbus, Ohio, October 11-14, 1972, Proceedings. Falls Church, Va., American Society of Photogrammetry, 1972. 489 p. Members, \$2.50; nonmembers, \$5.00.

Recent developments in aerial photographic equipment and mapping techniques are described in papers dealing with feature interpretation, reduction techniques, system calibration, error analysis, and test procedures. Topics considered include production of lunar charts from Apollo panoramic photography; evaluation of

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the Apollo 15 metric camera system; detection of snow cover and natural resources; application of multispectral remote sensing to problems of irrigation agriculture; resolving power of photogrammetric cameras; computer analysis of multispectral image densities; and analysis of lens distortion effects in reseau cameras.

T.M.

A73-21710 * The utility of a low flying aircraft or helicopter when collecting ground data for regional resource surveys. D. T. Lauer (California, University, Berkeley, Calif.). In: American Society of Photogrammetry and American Congress of Surveying and Mapping, Fall Convention, Columbus, Ohio, October 11-14, 1972, Proceedings. Falls Church, Va., American Society of Photogrammetry, 1972, p. 367-383. 6 refs. NASA-supported research. NASA Order R-03-038-002.

A73-22376 American Society of Photogrammetry, Annual Meeting, 38th, Washington, D.C., March 12-17, 1972, Proceedings. Falls Church, Va., American Society of Photogrammetry, 1972. 647 p. Members, \$2.50; nonmembers, \$5.00.

The subjects discussed include the calibration of close-range cameras, the use of vegetation as an indicator of soil salinity in an IR aerial survey, aerial photography applied to the study of ecological alterations in the Valley of Mexico, and the evaluation of a laser color recorder for earth resources research. A collinear theory of photogrammetry is considered, together with coastal boundary mapping, the photographic detection of potato leaf blight, and estimates of herbaceous standing crop by microdensitometry. Other topics investigated are related to computer techniques, an aerial surveillance spill prevention system, and an electronic viewer for multiband imagery.

G.R.

A73-22380 The business of looking down is looking up. C. E. Berndsen (U.S. Army, Engineer Topographic Laboratories, Wright-Patterson AFB, Ohio) and M. W. Onushco (USAF, Aerospace Cartographic and Geodetic Service, Forbes AFB, Kan.). In: American Society of Photogrammetry, Annual Meeting, 38th, Washington, D.C., March 12-17, 1972, Proceedings. Falls Church, Va., American Society of Photogrammetry, 1972, p. 318-331.

The advent of the Air Force's RC-135A/USQ-28 Mapping and Geodetic Survey System provides the U.S. mapping and geodetic community with a highly accurate mapping and geodetic surveying airborne data acquisition capability. The system can furnish the photogrammetrist with all of the orientation elements needed for the production of large scale Class A topographic maps. The inertial navigation subsystem consists of a digital computer, an inertial platform, a navigator's viewfinder, and a navigator's control panel. The photographic system is discussed, together with an airborne terrain profile recorder and electronic distance-measuring equipment.

G.R.

A73-22385 Geometric analysis of RBV television system. K. W. Wong, E. V. Gamble, and R. E. Riggins (Illinois, University, Urbana, Ill.). In: American Society of Photogrammetry, Annual Meeting, 38th, Washington, D.C., March 12-17, 1972, Proceedings. Falls Church, Va., American Society of Photogrammetry, 1972, p. 490-507. 8 refs. Research supported by the U.S. Geological Survey.

Three RBV television cameras will be flown on board the Earth Resources Technology Satellites (ERTS-A and B). Preliminary studies using laboratory RBV images showed that the total geometric distortion amounted to about plus or minus .445 mm at one sigma level, and the random component was about plus or minus .018 mm. Simulation studies on pre-flight and in-flight calibration showed that the focal length could be determined to within plus or minus 0.020 mm under the various system constraints in ERTS. Due to the narrow field angle of the TV camera, the position of the principal

point could be determined to within plus or minus 5 microns only when the direction of the optical axis was constrained to within plus or minus 10 seconds of arc.

(Author)

A73-22386 Remote sensing in hazy atmospheres. R. E. Turner (Michigan, University, Ann Arbor, Mich.). In: American Society of Photogrammetry, Annual Meeting, 38th, Washington, D.C., March 12-17, 1972, Proceedings. Falls Church, Va., American Society of Photogrammetry, 1972, p. 538-570. 6 refs.

There are several deleterious effects of atmospheric haze on remote sensor data. The simple radiative transfer model presented is especially adapted to hazy atmospheres. The model is used to define correction functions, which can be used to modify actual scanner data and hence remove variations in the data due to the atmosphere. The model can be extended to include the influence of background reflectance on target radiance.

G.R.

A73-22389 * The earth resources experiment package on Skylab and proposed resource investigations. A. B. Park (NASA, Office of Space Science and Applications, Washington, D.C.). In: American Society of Photogrammetry, Annual Meeting, 38th, Washington, D.C., March 12-17, 1972, Proceedings.

Falls Church, Va., American Society of Photogrammetry, 1972, p. 597-605.

In late 1973, NASA plans to launch a three-man experimental space station, the Skylab Workshop. Technical specifications regarding the instrumental facilities of the space station are presented, giving attention to the multispectral photographic facility, the IR spectrometer, the multispectral scanner, the L-band radiometer, and the S-193 sensor. The S-193 sensor will provide data applicable to studying varying ocean surfaces, wave conditions, sea and lake ice, ocean clouds, weather prediction, and soil types. All data from the sensors will be recorded on film and analog magnetic tape for return at the end of each manned period of Skylab.

G.R.

A73-22484 # Influence of atmospheric haze on the color of the underlying surface observed from a manned spacecraft (O vliianii atmosfernoï dymki na tsvet podstilaishchei poverkhnosti, nabludae-moi s pilotiruemogo kosmicheskogo korablia). K. Ia. Kondrat'ev and O. I. Smoktii (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR). *Akademiia Nauk SSSR, Doklady*, vol. 207, Nov. 1, 1972, p. 86-89. 8 refs. In Russian.

A73-24477 # Photometry of the planet Earth from Zond space stations (Fotometriia planety zemlia s kosmicheskikh stantsii "Zond"). N. P. Lavrova and A. B. Sandomirskii (Moskovskii Institut Inzhenerov Geodezii, Aerofotos'emki i Kartografii, Moscow, USSR). *Geodeziia i Aerofotos'emka*, no. 4, 1972, p. 109-114. 7 refs. In Russian.

Results of a photometric analysis of photographs of the earth obtained from Zond space stations. The sidereal magnitude of the earth is determined, and a patch of sunlight, which arose as a result of reflection of sun rays from a water surface, is noted on the planet.

A.B.K.

A73-26347 On the estimation of the directional spectrum of surface gravity waves from a programmed aircraft altimeter. R. L. Snyder (Nova University, Dania, Fla.). *Journal of Geophysical Research*, vol. 78, Mar. 20, 1973, p. 1475-1478. Contract No. N00014-67-A-0386-0001.

A method of determining the directional spectrum from the record of an aircraft-mounted (laser) altimeter is proposed. The method involves synchronous programming of the angle that the altimeter beam makes with the vertical and acquisition of the data. Subsequent analysis is similar to the directional spectrum analysis of the signals of a fixed array of wave recorders.

(Author)

A73-26965 # Determination of the polarization transfer function in space-based spectrophotometric observations of natural formations on a planetary surface (Ob opredelenii polarizatsionnoi peredatochnoi funktsii pri spektrofotometrirovanii izkosmosa prirodnykh obrazovaniy na poverkhnosti planety). K. Ia. Kondrat'ev and O. I. Smoktii (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR). *Akademiia Nauk SSSR, Doklady*, vol. 208, Jan. 1, 1973, p. 77-80. 7 refs. In Russian.

A73-27952 # The application of color and multispectral techniques to the collection of military geographic information. A. Anson (U.S. Army, Engineer Topographic Laboratories, Fort Belvoir, Va.). *International Society of Photogrammetry, International Congress for Photogrammetry, 12th, Ottawa, Canada, July 24-Aug. 4, 1972, Paper*. 29 p. 6 refs.

A73-27955 # The block adjustment of colour in high-altitude photography. S. H. Collins (Guelph, University, Guelph, Ontario, Canada). *International Society of Photogrammetry, International Congress for Photogrammetry, 12th, Ottawa, Canada, July 24-Aug. 4, 1972, Paper*. 9 p.

Description of a complete program of density calibration for color and multispectral high-altitude photography. The central technique is a 'block adjustment' of color, considered as a multi-dimensional variable, over a complete block of frame photography in a manner analogous to the block adjustment of point location in analytical photogrammetry. The images of selected ground areas are located in the overlaps between frames and between flight-lines. The colors of these 'pass points' are used to determine correction functions for color variations that occur within and between frames throughout the roll. The part of the sun-angle effect which is due to

A73-27958 # The Skylab S-190B Earth Terrain Camera. J. D. McLaurin (U.S. Geological Survey, McLean, Va.). *International Society of Photogrammetry, International Congress for Photogrammetry, 12th, Ottawa, Canada, July 24-Aug. 4, 1972, Paper*. 11 p. 5 refs.

The Earth Terrain Camera (ETC) is designed to supply high-resolution photographs of areas within the field of view of the other Earth Resources Experiment Package (EREP) sensors to aid in the interpretation of data gathered by them. The ETC is a modified version of the Lunar Topographic Camera carried on the Apollo 13 and 14 missions. The principal applications of ETC photographs will be in experiments where high resolution is required. Because the ETC is not a metric camera in the photogrammetric sense, its applications will be limited, but it is a significant advance in camera systems for earth resources observations from space. F.R.L.

A73-27963 The resolving power and the modulation transfer function of terrestrial and aerial cameras in working conditions. J. Hakkarainen (Finnish Research Council for Technical Sciences; Helsinki University of Technology, Helsinki, Finland). *International Society of Photogrammetry, International Congress for Photogrammetry, 12th, Ottawa, Canada, July 24-Aug. 4, 1972, Paper*. 17 p.

In 1971 two different test fields for the investigation of the resolving power (RP) and the modulation transfer function (MTF) under operating conditions were built in Finland, one for terrestrial cameras at the Helsinki University of Technology in Otaniemi, the other on the airfield of Malmi, near Helsinki. Both test fields consist of test patterns of the square-wave type suitable for microdensitometer measurements. According to the test photos the terrestrial cameras SMK 40, SMK 120, and TMK differ from each other considerably as regards the RP and the form of the RP curves. The test field of Malmi has been photographed with several different cameras under the same conditions. The RP and MTF have been determined from the aerial photographs; the latter has also been calculated with the edge gradient analysis. The differences between the RPs of the cameras under operating conditions seem to be small.

The effect of contrast is strong both when terrestrial and when aerial cameras are used. Also some settled areas have been photographed for the edge gradient analysis. (Author)

A73-27971 The calibration of aerial cameras for practical purposes. E. Welander and A. Smedberg (Geographical Survey of Sweden, Stockholm, Sweden). *International Society of Photogrammetry, International Congress for Photogrammetry, 12th, Ottawa, Canada, July 24-Aug. 4, 1972, Paper*. 11 p.

Every year the Geographical Survey Office of Sweden tests its aerial cameras in the laboratory and under operational conditions. Nonflatness of the film at the exposure moment has a very important influence on the geometrical qualities of the photographs. The determination of flatness is performed using a control plane consisting of a ground diabase flag of high accuracy. The measurements are performed by means of a dial indicator on a stand. Ice surface photography has been the main method used for the routine, geometrical tests of the cameras. F.R.L.

A73-28276 Skylab's bird's-eye view of earth's resources. *Optical Spectra*, vol. 7, Apr. 1973, p. 27-35.

Scheduled for launching in May, Skylab A will make use of existing Gemini and Apollo hardware in earth orbit. The study objectives include in addition to solar studies also a synoptic survey of selected areas on the earth in visible, IR, and microwave spectrum regions. The S-190 multispectral photographic facility is discussed together with the S-190 lenses, the purposes of the S-190, the S-191 IR spectrometer, a viewfinder tracker, the S-192 multispectral scanner, the S-193 microwave system, aspects of internal calibration, and questions of energy collection. Details of operation and evaluation are also considered along with questions of operations rationale. G.R.

A73-28889 # Potential capabilities of Doppler measurement systems employing spectral compression (O potentsial'nykh vozmozhnostiakh Dopplerovskikh izmeritelei so szhatiem spektra). V. G. Gurevich and B. V. Malanov. *Radiotekhnika*, vol. 28, Feb. 1973, p. 9-15. 6 refs. In Russian.

The potential advantages that can be expected from the use of echo signal compression in an airborne FM Doppler radar are evaluated with allowance for the surface characteristics of the distributed target, the envelope of the emitted signal, and the orientation of the radiation pattern relative to the flight trajectory. It is shown that the Doppler ambiguity function of a signal reflected from a multiple target (such as the earth's surface) undergoes changes during spectral expansion of the emitted signal in the course of frequency modulation. Compression of the Doppler ambiguity function of a signal reflected from a multiple target requires the use of a frequency modulator whose modulation rule is based on a priori information about the flight trajectory and the structure of the distributed target. T.M.

A73-29239 Atmospheric effects in multispectral photography. D. S. Ross (International Imaging Systems, Mountain View, Calif.). (*American Society of Photogrammetry and American Congress of Surveying and Mapping, Annual Convention, Washington, D.C., Mar. 12-17, 1972, Photogrammetric Engineering*, vol. 39, Apr. 1973, p. 377-384. 9 refs.

A simple method of estimating gross atmospheric effects on distorting multispectral image contrast is based on a graphical solution using image density measurements of bright and dark terrain reference areas of known (or estimated) spectral reflectances. The density data are normalized to the sensitometric spectral-response film curves in a way which compensates for variations in response-curve shape, film processing, filter factors, exposure, atmospheric radiance, and spectral attenuation. The order of spectral reflectance in parts of the scene other than the reference areas may be assessed and a comparison of spectral response between bands can be made. (Author)

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A73-29326 # A high performance large aperture window for photography from a space platform. C. J. Choccol. *Optical Society of America, Fall Meeting, San Francisco, Calif., Oct. 17-20, 1972, Paper, 16 p.*

Discussion of a photographic window design with a wedge of 2 arc sec maximum, spectral range from 0.4 to 0.9 microns, reflection below 2%, transmittance of 80% and veiling glare below 1%. The good performance of the window on spacecraft is noted. V.Z.

A73-28331 * # Performance of optical surfaces in space. J. J. Horan, D. S. Schwartz (General Electric Co., Space Div., Valley Forge, Pa.), and J. D. Love (Hughes Aircraft Corp., El Segundo, Calif.). *Optical Society of America, Spring Meeting, Denver, Colo., Mar. 13-16, 1973, Paper, 33 p. Contract No. NAS5-11320.*

The Multispectral Scanner carried by the ERTS-1 satellite (launched on July 23, 1972) is a very high resolution line scanning imaging radiometer operating in the visible and near infrared spectral regions. The instrument contains optical surfaces that are exposed to both direct and reflected sunlight, and the reflectivity and transmission of some of these surfaces have decreased in orbit. Details of the optical system are explained, and data on the degradation are reviewed as a function of both spectral interval and time in orbit. The history of the scanner during testing (when hydrocarbons from an external source may have been deposited on the optical surfaces) is also examined, and a mechanism is postulated for the observed degradation in orbit. T.M.

A73-29412 # Capabilities of the GS-12 gravimeter for studying gravitational field variations (Vozmozhnosti gravimetra GS-12 dlia izucheniia variatsii gravitatsionnogo polia). M. Kurbanov and B. N. Gaipov (Akademila Nauk Turkmenkoi SSR, Institut Fiziki Zemli i Atmosfery, Ashkhabad, Turkmen SSR). *Akademila Nauk Turkmenkoi SSR, Izvestiia, Seria Fiziko-Tekhnicheskikh, Khimicheskikh i Geologicheskikh Nauk*, no. 6, 1972, p. 121-123. 6 refs. In Russian.

A73-33351 Operational remote sensing; Proceedings of the Seminar, Houston, Tex., February 1-4, 1972. Seminar sponsored by the American Society of Photogrammetry, Falls Church, Va., American Society of Photogrammetry, 1972. 341 p. Members, \$5.00; nonmembers, \$10.00.

A section of the papers devoted to remote sensing in space covers the present and future environmental satellite systems, Apollo lunar orbital science, and mapping of Mars with MM '71 pictures. Remote sensing at low and high altitudes is treated, as well as the processing and presentation of remote sensor data. Remote sensor imagery for military geographic information is evaluated, and digital data processing and analysis and hybrid techniques for automatic imagery interpretation are investigated.

Individual items are announced in this issue.

F.R.L.

A73-33358 Controlled-quality images from synthetic-aperture radar data. R. B. Innes (Michigan, University, Ann Arbor, Mich.). In: Operational remote sensing; Proceedings of the Seminar, Houston, Tex., February 1-4, 1972. Falls Church, Va., American Society of Photogrammetry, 1972, p. 116-122; Discussion, p. 123.

Major attention is given to the capability of a synthetic-aperture system to accurately simulate images that could be created by other side-looking radars of either the real-aperture or synthetic-aperture types whose overall image quality is less than that in the system described. The capability is provided by post-flight ground-based

data processing which consists in selecting, from the large amount of fine-detail data on the film, that part which one of two radars would have collected and then using only that part to form the image. Because the data processor used is an optical device, it is possible to select the desired data sets merely by placing obstacles and apertures so as to block unwanted data and admit the wanted data to the image frame. It is also possible, though difficult, to combine images obtained at different times. F.R.L.

A73-33365 Evaluation of remote sensor imagery for military geographic information. T. C. Vogel and M. J. Lynch (U.S. Army, Engineer Topographic Laboratories, Fort Belvoir, Va.). In: Operational remote sensing; Proceedings of the Seminar, Houston, Tex., February 1-4, 1972. Falls Church, Va., American Society of Photogrammetry, 1972, p. 196-207.

This work is an initial attempt to evaluate twenty selected remote sensors for their ability to obtain data on specific natural and cultural terrain components (81 selected military geographic information /MGI/ elements). The evaluations were made at four levels, according to the complexity of the MGI element and the level of experience required from the interpreter. The MGI elements were categorized into four major divisions: (1) drainage and water, (2) vegetation, (3) landforms and surficial materials, and (4) cultural and industrial economics. While the evaluations were based on a review of the scientific and industrial literature, they were tempered with the experience and background of project personnel. (Author)

A73-33657 # The University of Wyoming Global Monitoring Program. T. J. Papin, J. M. Rosen, D. J. Hofmann (Wyoming, University, Laramie, Wyo.), and J. L. Kroening (Minnesota, University, Duluth, Minn.). *American Institute of Aeronautics and Astronautics and American Meteorological Society, International Conference on the Environmental Impact of Aerospace Operations in the High Atmosphere, Denver, Colo., June 11-13, 1973, AIAA Paper 73-521. 8 p. 6 refs. Members, \$1.50; nonmembers, \$2.00. Contract No. N00014-70-A-0266-0005.*

In 1971 a program was begun to make bimonthly balloon soundings to determine the vertical profile of submicron dust in two size ranges, the ozone, water vapor, and temperature from eight different stations distributed in both the northern and southern hemispheres. Additional soundings are made from both poles each winter. A continuing effort is being made to improve the present balloon instrumentation and to allow for the determination of additional atmospheric constituents. In addition, remote-sensing techniques that have been used from balloons are being adapted to satellite platforms to enable global determinations of the stratospheric aerosols. (Author)

A73-33701 Propagation of radio waves at frequencies above 10 GHz; Proceedings of the Conference, London, England, April 10-13, 1973. Conference sponsored by the Institution of Electrical Engineers, London, Institution of Electrical Engineers (IEE Conference Publication, No. 98), 1973. 269 p. \$22.65.

Single and dual path propagation at 18 GHz with application to the design of digital radio relay systems, methods for investigating the effects of multipath fading on 2-phase digital radio systems, and correction of electrical path length by passive microwave radiometry are among the topics covered in papers concerned with the propagation of radio waves at frequencies above 10 GHz. Other topics covered include linear and circular cross-polarization statistics, the influence of the sea evaporation duct on the phase of the received field on a line-of-sight path, and results from a three-radiometer path diversity experiment.

M.V.E.

A73-34750 The compensation method for measuring the components of the earth's magnetic field. J. A. As (Koninklijk Nederlands Meteorologisch Instituut, De Bilt, Netherlands). *Zeitschrift für Geophysik*, vol. 39, May 1973, p. 303-311. 7 refs.

A generalized theory of Nelson's vector magnetometer is given for the determination of the absolute values of the components of

the earth's field vector. A compensation method is also described for observation of the variations of the field. Using a fixed frame with three orthogonal coils, measurements of the components in the three directions of the coil axes can be made by the proton magnetometer. These measurements represent the absolute values of the components. (Author)

A73-34927 # Global Atmospheric Research Programme. B. J. Mason (Meteorological Office, Bracknell, Berks., England). In: The control of the terrestrial environment from space: International collaboration, methods and technologies; International Conference on Space, 13th, Rome, Italy, March 22-24, 1973, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1973, p. 23, 25-41. 6 refs.

Detailed review of the aims and plans of the Global Atmospheric Research Program (GARP). The present status of numerical modeling of the global circulation, of numerical weather prediction, and of the global observational system on which GARP programs will have to build is summarized, and some of the major deficiencies and difficulties encountered in building numerical models of the global circulation of the atmosphere are considered. The chief objective of the GARP tropical experiment planned for 1974 in the eastern Atlantic is outlined (an experiment dealing with the genesis and growth of deep convective cloud systems). The observations required to represent and predict the atmospheric processes that will determine the essential features of the weather everywhere for a week or more ahead are noted. The use of sophisticated spectrometers and radiometers to obtain vertical distributions of atmospheric temperature by remote sensing of infrared radiation is discussed. A.B.K.

A73-34935 # Role of the meteorological satellites of the earth atmosphere observation system for the first global experiment of the 'Global Atmospheric Research Programme' (Ruolo dei satelliti meteorologici nel sistema di osservazione dell'atmosfera terrestre per la prima esperienza globale del 'Global Atmospheric Research Programme'). B. Bizzarri (Aeronautica Militare, Servizio Meteorologico, Rome, Italy). In: The control of the terrestrial environment from space: International collaboration, methods and technologies; International Conference on Space, 13th, Rome, Italy, March 22-24, 1973, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1973, p. 151, 153-159. 5 refs. In Italian.

A73-34945 # Satellite sensing of land resources. J. A. Howard (United Nations, Food and Agriculture Organization, Rome, Italy). In: The control of the terrestrial environment from space: International collaboration, methods and technologies; International Conference on Space, 13th, Rome, Italy, March 22-24, 1973, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1973, p. 265, 267-272. 15 refs.

Since each satellite image covers an extensive ground area, it provides a synoptic view and gives unique spatial dependent information not readily discernible on even small-scale conventional aerial photographs. Orbital speed and satellite longevity favor the collection and use of time-dependent information obtained by repeated observations of the same area. A summary of information to be observed from satellite imagery, is presented and details of ERTS imagery are being considered. G.R.

A73-34953 Rockets for earth environment monitoring. N. Simmons (Ministry of Defence, London, England). In: The control of the terrestrial environment from space: International collaboration, methods and technologies; International Conference on Space, 13th, Rome, Italy, March 22-24, 1973, Proceedings.

Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1973, p. 363, 365-371.

Rockets have been extensively employed for point measurements in the earth's atmospheric and ionospheric environment. These

sounding rockets have been adapted in the UK to ground monitoring by the methods of remote sensing. The Skylark rocket constitutes a natural starting-point for earth monitoring work since, in addition to its sounding capabilities, it is able to operate in an attitude-stabilized mode. Smaller British rockets are also discussed together with details of practical applications. G.R.

A73-34957 # Stereoscopic line scanning in the infrared. D. Lorenz (Meteorologisches Observatorium, Hamburg, West Germany). In: The control of the terrestrial environment from space: International collaboration, methods and technologies; International Conference on Space, 13th, Rome, Italy, March 22-24, 1973, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1973, p. 415, 417-425. 8 refs.

Optical-mechanical scanning is a very important method of remote sensing of the earth's surface, and was introduced in recent years especially in conjunction with infrared line scanners. It is of great advantage if images of infrared line scanners can be interpreted stereoscopically. This is intended especially for a complicated topographic terrain. Using this method from meteorological satellites, clouds at different altitudes, as well as clouds and snow-covered ground with similar temperatures, may become distinguishable. Stereoscopic viewing needs two images taken from different points of view. Convergent camera systems and scanner cameras are considered. F.R.L.

A73-34958 # Passive microwave radiometry and its potential applications to earth resources surveys. E. Ohlsson (Saab-Scania A.B., Linköping, Sweden). In: The control of the terrestrial environment from space: International collaboration, methods and technologies; International Conference on Space, 13th, Rome, Italy, March 22-24, 1973, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1973, p. 427, 429-437. 6 refs.

A73-35357 Annual Southwestern Conference and Exhibition, 25th, Houston, Tex., April 4-6, 1973, Record. Conference sponsored by the Institute of Electrical and Electronics Engineers. Edited by J. D. Evans (Boeing Co., Houston, Tex.). New York, Institute of Electrical and Electronics Engineers, Inc., 1973. 633 p. Members, \$15.; nonmembers, \$20.

General areas covered by the papers include modern control theory and applications, mathematical modeling and computer techniques applied to biological systems, electromagnetic wave propagation, biomedical systems and instrumentation, hybrid computation for stochastic systems, electric machine dynamics and control, Skylab experiment systems, antennas and microwave systems, estimation, technological effects on society, communication theory, analog/hybrid computation in education, computer system reliability and maintainability, circuit theory, fusion engineering and technology, aerospace and electronic systems, digital filters, electron devices, and optimization.

T.M.

A73-35365 * Remote sensing technology - The 24-channel multispectral scanner. H. S. Hayre (Houston, University, Houston, Tex.) and R. R. Richard (NASA, Johnson Space Center, Houston, Tex.). In: Annual Southwestern Conference and Exhibition, 25th, Houston, Tex., April 4-6, 1973, Record. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. 89-96. 5 refs.

The multispectral scanner system installed in the NASA C-130 aircraft for use in the Earth Observations Aircraft Program constitutes a 24-channel imaging spectrometer that senses electromagnetic energy in the spectral interval from .34 to 13 microns. Energy reflected or emitted from the terrain and system calibration sources is collected by a scan mirror, reflected into collecting optics, and brought to a focus in a plane containing a 0.09 inch square aperture. A dichroic optical element splits the energy which passes through the

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aperture into two wavelength bands (wavelengths above and below 2 microns). These wavelength bands are then dispersed spectrally into 24 distinct spectral bands by two grating spectrometers. The spectral intervals are transformed into electrical signals by separate detector-preamplifier combinations, and the signals are used as inputs to a video processor in an airborne electronics console. System operation and performance are described. T.M.

A73-35436 * Single step detection of blurred images in a coherent optical processor. D. P. Jablonowski and S. H. Lee (Carnegie-Mellon University, Pittsburgh, Pa.). *Applied Optics*, vol. 12, July 1973, p. 1713-1716. 6 refs. NASA-supported research.

Two important operations that can be performed by coherent optical processing systems are image detection and image restoration. These operations require complex spatial filters, and if both operations are to be performed, cascaded processing stages employing two separate spatial filters are usually needed. Spatial filters are described that will perform in a single step both operations simultaneously, thus eliminating the need for extra processing stages while providing the advantages of higher efficiency and smaller space requirements. The filters are characterized by their simplicity and are easily fabricated using conventional techniques. Experimental results are presented. (Author)

A73-35577 # Airborne infrared imaging system. E. N. Brown (National Center for Atmospheric Research, Boulder, Colo.) and F. L. Scarpace (Wisconsin, University, Madison, Wis.). *Atmospheric Technology*, Mar. 1973, p. 43-48. 10 refs.

Description of the design, operation, performance, and typical measurements of the Texas Instruments RS-310 airborne passive IR line scanner used to view large areas of underlying terrain with excellent spectral resolution and thermal sensitivity between 0.3 and 14.0 microns. Velocity and height controls are monitored during each mapping flight to provide contiguous line imagery, while the video current to the light-emitting diode is displayed on an oscilloscope so that the operator can maintain the desired image contrast. The instrument is roll stabilized and includes a provision for boresighting. Various applications requiring measurements of surface temperatures over land and water are discussed. T.M.

A73-35639 Remote sensing using microwave radiometry. K. R. Carver (New Mexico State University, Las Cruces, N. Mex.). In: *Electrical engineering - Service to mankind; Proceedings of the Southeast Region 3 Conference*, Louisville, Ky., April 30-May 2, 1973. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. H-7-1 to H-7-6. 9 refs.

A tutorial review of microwave radiometric remote sensing is presented, with emphasis on the fundamental principles of radiometry. Factors affecting radiation from the earth's surface, emissivity models for rough surfaces, and interaction of radiation with the earth's surface and atmosphere are considered. Basic techniques of instrumentation are outlined by discussing requirements for antennas, receivers, and output recording devices; environmental monitoring capabilities of microwave radiometric remote sensors are summarized. T.M.

A73-35815 # Teledetection experiments using balloons (Les expériences de télédétection par ballons). L. Laidet (Centre National d'Etudes Spatiales, Paris, France). *Industries Atomiques et Spatiales*, vol. 17, Mar.-Apr. 1973, p. 58-64. In French.

Tropospheric or stratospheric balloons reach high altitudes and can play an important role in teledetection because of their relatively low cost, ability to carry appreciable payloads, and ability to stay airborne for long periods. The most immediate utilization of the aerostat in teledetection is doubtless in photography, which makes possible observation of the ground in the 0.4 to 0.9 micron range of the electromagnetic spectrum. An experiment carried out by CNES made use of two on-board cameras. A special device controlled opening of the shutter as a function of the intensity of the light flux received. Characteristics of the hydrogen balloon used are described, and some future possibilities are outlined. F.R.L.

A73-35957 # Satellite measurements of atmospheric composition in the altitude range 150 to 450 km. C. R. Philbrick (USAF, Cambridge Research Laboratories, Bedford, Mass.). *COSPAR, Plenary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper*. 13 p. 16 refs.

A73-36018 # A low-cost system for reproducing ERTS imagery. J. S. MacDonald, D. S. Sloan (MacDonald, Dettwiler and Associates, Ltd., Vancouver, Canada), R. E. Barrington, and W. Rolfe (Department of Communications, Communications Research Centre, Ottawa, Canada). *COSPAR, Plenary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper*. 12 p.

A system is described which is capable of reproducing the scanner (MSS) or vidicon (RBV) imagery from ERTS at full resolution and relatively moderate cost. This system, which uses a high resolution CRT system and photographic film to display and record the data, has demonstrated its ability to produce high-quality imagery at both the Canadian and Brazilian ERTS ground stations. The system, in its simplest form, reproduces an unannotated image from one MSS or RBV spectral band at a time. The MSS images are corrected for line length, sinusoidal scan and S-bend distortions. This system has proven very useful as a check-out of the total ground station and of some of its components, such as tape recorders, and provides a simple yet effective method for quality control of the tapes shipped from the ground station. More important, it provides the first available indication of the quality of the imagery that has been recorded from the satellite. (Author)

A73-36029 # Vertical temperature profiles from satellites - Results from second generation instruments aboard Nimbus-5. W. L. Smith (NOAA, National Environmental Satellite Service, Washington, D.C.), D. H. Staelin (MIT, Boston, Mass.), and J. T. Houghton (Oxford University, Oxford, England). *COSPAR, Plenary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper*. 41 p.

A73-36041 # Remote sensing with VHRR satellite imagery. H. Kaminski (Institute for Space Research, Observatory, Bochum, West Germany). *COSPAR, Plenary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper*. 8 p. 6 refs.

Possible uses of synoptic satellite photography in the visible and infrared ranges are demonstrated, using selected areas in Europe, the Mediterranean, and North Africa as examples. The application of VHRR (Very High Resolution Radiometer) imagery to the investigation of static and ephemeral phenomena on the earth surface is discussed with particular reference to the NOAA 2 and NOAA 3 weather satellites. V.P.

A73-36136 # Wind measurement by magnetometers, optical and static pressure sensors. A. S. Butko. *COSPAR, Plenary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper*. 7 p. 6 refs.

A method of using big meteorological rockets is described which makes it possible to measure wind in the daytime and during the periods of full moon at night. The three-component magnetometer sensors were arranged in such a way that positive directions of their magnetic axes formed a right-hand rectangular coordinate system rigidly connected with the rocket body. The optical and static pressure sensors were oriented in such a way that their normals to inlet port planes lay in one plane. The data of two rocket firings carried out during the 'sun-atmosphere 1971' experiment are plotted and discussed. F.R.L.

A73-36874 Optimum parameters of an infrared imaging system for aerial scanning of earth resources. E. Ia. Karizhenskii, M. M. Miroshnikov, and B. V. Shilin. (*Optiko-Mekhanicheskaya Promyshlennost'*, vol. 39, Dec. 1972.) *Soviet Journal of Optical Technology*, vol. 39, Dec. 1972, p. 739-741. 7 refs. Translation.

Evaluation of the quality of a technique which uses IR aerial imaging systems with two channels having different resolutions and sensitivity thresholds for earth resources surveys and studies. Suggestions are given for parameter selection to optimize the performance of such imaging systems. V.Z.

A73-37301 * Remotely manned systems: Exploration and operation in space; Proceedings of the First National Conference, California Institute of Technology, Pasadena, Calif., September 13-15, 1972. Conference sponsored by NASA and California Institute of Technology. Edited by E. Heer. Pasadena, Calif., California Institute of Technology, 1973. 511 p. \$25.

Free-flying teleoperator systems are discussed, giving attention to earth-orbit mission considerations and Space Tug requirements, free-flying teleoperator requirements and conceptual design, system requirements for a free-flying teleoperator to despin, and the experimental evaluation of remote manipulator systems. Shuttle-Attached Manipulator Systems are considered, together with remote surface vehicle systems, manipulator systems technology, remote sensor and display technology, the man-machine interface, and control and machine intelligence. Nonspace applications are also explored, taking into account implications of nonspace applications, naval applications of remote manipulators, and hand tools and mechanical accessories for a deep submersible.

G.R.

A73-37335 * A survey study of teleoperators, robotics, and remote systems technology. A. D. Alexander, III (NASA, Advanced Concepts and Missions Div., Moffett Field, Calif.). In: Remotely manned systems: Exploration and operation in space; Proceedings of the First National Conference, Pasadena, Calif., September 13-15, 1972. Pasadena, Calif., California Institute of Technology, 1973, p. 449-458.

Survey of the current status and major R&D needs of remote systems technology in the medical, mining, and oceanographic areas of application. The review is limited to the most important teleoperator/robotic subsystems, including actuators, sensors, control and communication devices. M.V.E.

A73-37497 * # Remote sensing - The application of space technology to the survey of the earth and its environment. R. J. Schertler (NASA, Lewis Research Center, Cleveland, Ohio). *National Science Teachers Association, National Convention, Detroit, Mich., Mar. 30-Apr. 4, 1973, Paper. 12 p.*

A73-37712 The growth of remote sensing through the Nimbus and ERTS spacecraft. I. S. Haas and J. J. Horan (General Electric Co., Philadelphia, Pa.). In: Astronautical research 1971; Proceedings of the Twenty-second Congress, Brussels, Belgium, September 20-25, 1971. Dordrecht, D. Reidel Publishing Co., 1973, p. 389-401.

Review of the development of imaging systems and remote sensor technology used in the Nimbus and ERTS programs. The use of television imagery in the visible range for remotely sensing the earth and its atmospheric environment is discussed, citing such cameras as the advanced vidicon camera system, the automatic picture transmission system, and the image dissector camera system, which form the basis for the evolutionary development of the return beam vidicon camera system to be flown on the first ERTS satellite. Other imaging aids, such as the high-resolution IR radiometer on Nimbus 1, a temperature humidity IR radiometer, and a surface composition mapping radiometer to be flown on Nimbus E, are also discussed. Among the sensors discussed are the electrically scanned microwave radiometer antenna to be used in the Nimbus E spacecraft, and the multispectral scanner and return beam vidicon to be flown on the first ERTS satellite. A.B.K.

A73-38176 Remote sensing of terrestrial resources (La télédétection des ressources terrestres). A. Alouges and L. Laidet

(CNES, Paris, France). *La Recherche Spatiale*, vol. 12, July-Aug. 1973, p. 1-6. In French.

Remote sensing involves the study of the behavior of the terrestrial surface and of the atmosphere with reference to radiations whose wavelengths can range from the ultraviolet to radio wavelengths, the study of technical means making it possible to receive radiations, and the study of methods of analysis of received data in order to extract the desired information. The sources of radiation, transmission disturbances detectors, vehicles, and data processing are discussed. The activities of CNES in remote sensing are briefly described. F.R.L.

A73-38177 Equipment for checking of terrestrial resources (Les équipements pour l'expérimentation des ressources terrestres). A. Goebels (CNES, Paris, France). *La Recherche Spatiale*, vol. 12, July-Aug. 1973, p. 7-12. In French.

The Group for Checking of Terrestrial Resources has available a certain amount of remote sensing equipment which makes it possible to recover, store, transmit, and visualize information concerning different radiations emitted by or reflected from the terrestrial surface. These include photographic apparatus, a multispectral optical scanning system of remote sensing and visualization (Dae-dalus), the Sangamo recorder, an infrared remote sensing system, and an infrared radiometer. F.R.L.

A73-38180 Remote sensing experiments with balloons (Les expériences de télédétection par ballons). L. Laidet (CNES, Paris, France). *La Recherche Spatiale*, vol. 12, July-Aug. 1973, p. 19-22. In French.

The most immediate utilization of the balloon for remote sensing is photography which makes possible an observation of the earth in the 0.4 to 0.9 micron range of the electromagnetic spectrum. At present, stratospheric balloons can be used for testing in the space environment of various equipment such as scanning devices and photographic detectors. Some experiments carried out by CNES are reviewed, and the advantages of free and geostationary balloons are discussed. F.R.L.

A73-38211 A note on the FM-CW radar as a remote probe of the Pacific Trade-Wind Inversion. B. R. Bean, R. E. McGavin (NOAA, Wave Propagation Laboratory, Boulder, Colo.), and B. D. Warner (NOAA, Institute for Telecommunication Sciences, Boulder, Colo.). (Inter-Union Commission on Radio Meteorology, Symposium on Waves and Turbulence in Stable Layers and their Effects on EM Propagation, 3rd, La Jolla, Calif., June 5-15, 1972.) *Boundary-Layer Meteorology*, vol. 4, Apr. 1973, p. 201-209. 6 refs.

A73-38577 # Radio frequency sensors. R. K. Moore (Kansas, University, Lawrence, Kan.). *American Astronautical Society, Annual Meeting, 19th, Dallas, Tex., June 19-21, 1973, Paper 73-111. 18 p. 17 refs.*

Microwave sensors provide the unique opportunity to collect information about the earth on demand, with little regard for weather and lighting conditions. Since most users of earth observations require relatively fine resolution pictures, synthetic aperture side-looking radar (SLR) is the most promising spacecraft microwave device. With such a system, the resolution can be made independent of distance. Many applications of airborne SLR have already been demonstrated, and the systems are in commercial use today. Poorer resolutions that go with microwave radiometers and nonsynthetic aperture scatterometers have special applications to meteorology and oceanography. (Author)

A73-38578 # Sensor development - An overview of recent Canadian experience. J. MacDowall (Department of Energy, Mines and Resources, Canada Centre for Remote Sensing, Ottawa, Canada)

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and P. A. Lapp (P. A. Lapp, Ltd., Toronto, Canada). *American Astronautical Society, Annual Meeting, 19th, Dallas, Tex., June 19-21, 1973, Paper 73-114*. 28 p. 5 refs.

Since 1970, the Canada Centre for Remote Sensing has sponsored a program to cultivate existing centers of expertise in the development of instrumentation for remote sensing purposes. A complementary world-wide survey of sensors was conducted in an attempt to keep the program in perspective of world development and to minimize overlap. In the first year, twelve programs were supported, several programs have now completed the first round of field trials. The devices utilize various parts of the electromagnetic spectrum in both passive and active modes. Particular emphasis was laid on sensors with this capability for matching spectral signatures of earth-, water-, and air-, resource targets. The paper outlines the nature of the resulting equipment, summarizes the major achievements to date, and indicates the most likely applications for the devices as illustrated by preliminary field trials results. (Author)

A73-38579 # The use of remote sensing in the USSR for the study of natural resources. V. B. Komarov (Ministry of Geology Laboratory of Aeromethods, Leningrad, USSR). *American Astronautical Society, Annual Meeting, 19th, Dallas, Tex., June 19-21, 1973, Paper 73-115*. 9 p.

Plans calling for the efficient development and exploration of the natural resources of the USSR must be based on concrete data concerning the location and distribution of these resources within the vast territory of that country. In order to obtain the required data, it is necessary to develop remote sensing methods based on devices carried by aircraft. These methods make use of the EM spectrum and a number of parameters of the terrestrial EM and gravitational fields. Objectives of aerial photography are considered together with the recording of gamma radiation, aspects of thermal surveys, and the advantages of investigations based on radar. Satellite-based surveys are to supplement the studies conducted with aircraft. G.R.

A73-38585 # Atmospheric sounding from an earth satellite. R. M. Scott (Ball Brothers Research Corp., Boulder, Colo.). *American Astronautical Society, Annual Meeting, 19th, Dallas, Tex., June 19-21, 1973, Paper 73-125*. 23 p. 27 refs.

Techniques have been developed from experiments on Nimbus satellites and on aircraft and balloon flights which allow accurate sounding of the atmosphere from remote sensors aboard earth satellites. These soundings consist of radiometric radiance measurements to help determine the temperature and quantity profiles of some important constituents of the atmosphere, in particular carbon dioxide, ozone, and water vapor. Measurements can be made of the earth's reflected and emitted radiance looking down through the atmosphere in the visible, IR, and microwave bands. Measurements in the visible spectrum determine cloud cover. By applying mathematical inversion and statistical or iteration techniques, the general radiative transfer equation can be used to deduce the vertical temperature profile, O₃, and H₂O quantities. (Author)

A73-38591 # Study of laser remote sensing techniques from space platforms. J. J. Grossman, H. G. Gross, and H. A. Hyatt (McDonnell Douglas Astronautics Co., Space Sciences Dept., Huntington Beach, Calif.). *American Astronautical Society, Annual Meeting, 19th, Dallas, Tex., June 19-21, 1973, Paper 73-136*. 24 p. 22 refs.

Review of the possibility of active remote sensing of the earth's environment from satellite platforms. Various types of lasers are considered as sources for monitoring global and local aerosol and gas profiles at low concentrations in the troposphere and stratosphere. Subsequent spectroscopic analysis of the photoluminescence, resonance fluorescence, and Raman scattering return signal is considered for the various atmospheric, oceanic, and continental domains. Different lidar transmitter and receiver geometries (monostatic and bistatic) are given in order to compare the best approach

to detection of particular species by optimizing the signal to noise ratio. (Author)

A73-39838 # Microwave radiometry at the DFVLR, Oberpfaffenhofen, Germany. M. Vogel (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Flugfunk und Mikrowellen, Oberpfaffenhofen, West Germany). In: *International Symposium on Remote Sensing of Environment*, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1.

Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 199-216. 15 refs.

The relations between radiation intensities measurable as functions of aspect, polarization, frequency, time, and the parameters of smooth and rough materials, terrain, and single objects are discussed. These data are needed to design a system for a specific task, or to derive meaningful information from passive microwave observations. Early ground mapping experiments at 35 GHz, a self-calibrating 11 GHz radiometer, measurements with the 11 GHz radiometer, airborne radiometers for 32 and 90 GHz, and the radiometry of the atmosphere are described, and information obtainable by microwave radiometry is given. F.R.L.

A73-39844 # Satellite measurements of microwave and infrared radiobrightness temperature of the earth's cover and clouds. A. E. Basharinov, A. S. Gurvich, A. K. Gorodetskii, S. T. Egorov, B. G. Kutuza, A. A. Kurskaia, D. T. Matveev, A. P. Orlov, and A. M. Shutko (Akademiia Nauk SSSR, Institut Fiziki Atmosfery and Institut Radiotekhniki i Elektroniki, Moscow, USSR). In: *International Symposium on Remote Sensing of Environment*, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1.

Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 291-296. 6 refs.

A73-39852 * # Design and performance characteristics of the Vertical Temperature Profile Radiometer /VTPR/ for atmospheric temperature soundings. G. Falbel (Barnes Engineering Co., Stamford, Conn.). In: *International Symposium on Remote Sensing of Environment*, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 409-440. 6 refs. NASA-sponsored research.

Description of the design and operation of a radiometer which derives atmospheric temperature profiles on the basis of spectral measurements in eight optical filter channels. The radiometer achieves its eight-channel capability by sequentially viewing the eight optical filters mounted in a rotating filter wheel, with a single IR detector and electronic amplification channel processing the signal for all the filters. The advantages and disadvantages of this sequential approach as compared to eight 'parallel' radiometric channels are discussed. The proposed radiometer provides a relative calibration accuracy between seven out of the eight channels of better than 0.1% rms of the full dynamic range. The absolute accuracy achievable between in-flight calibrations of six minutes, or between two-hour calibrations using optical temperature correction factors, is better than an rms value of 0.15% of full scale. The radiometric correlation between the in-flight calibration source of the instrument and a reference standard blackbody is better than an rms value of 0.5% of full scale. A.B.K.

A73-39855 * # Remote sensing of atmospheric O₃ and H₂O to 70 km by aircraft measurements of radiation at 1.64 mm wavelength. J. W. Waters (MIT, Cambridge, Mass.). In: *International Symposium on Remote Sensing of Environment*, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1.

Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 467-473. 14 refs. Research supported by the California Institute of Technology; Contracts No. NAS1-10693; No. JPL-95268.

A73-39856 # Remote sensing of stratospheric gases using submillimetre radiation. J. E. Harries (Aeronautical Research Council, National Physical Laboratory, Teddington, Middx., England). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 475-486. 16 refs.

This paper summarizes extensive studies which have been made of the submillimetre (far infrared) spectrum of the stratosphere. Using first a Golay cell detector, then a more sensitive cooled InSb bolometer, with a Michelson interferometric spectrometer, high altitude spectra have been obtained at resolutions of up to 0.06/cm. From these, measurements of H₂O, O₃, HNO₃, N₂O and NO₂ have been made, from several aircraft and a balloon. The techniques used, results obtained, and the future developments of this work are discussed. (Author)

A73-39857 # Remote sensing of mesospheric ozone. J. E. Rudzki, Jr. (USAF, Avionics Laboratory, Dayton, Ohio). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 487-504. 27 refs.

Results of microwave measurements of the diurnal variation of the concentration of mesospheric ozone. Although photochemical theories describe some of the gross features of the ozone concentration profile satisfactorily, one key point of the theory is that the concentration of mesospheric ozone should vary diurnally, increasing at night and decreasing during the day. A radiometer built to test this theory is described, and experimental results obtained with the aid of this radiometer are cited which place an upper limit on the nighttime mesospheric ozone concentration of 50 billion per cu cm at 50 km, dropping exponentially to one billion per cu cm at 80 km. These findings are in contradiction to the analysis of Hunt which predicts that the mesospheric ozone concentration near 70 km altitude increases diurnally to around 50 billion per cu cm at night from a daytime concentration of about one billion per cu cm. A.B.K.

A73-39858 # Some results of spectrophotometric studies of natural formations from the manned spacecraft 'Soyuz-9'. K. Ia. Kondrat'ev, A. A. Buznikov, O. B. Vasil'ev, B. V. Vinogradov, V. M. Orlov, V. I. Sevastianov, and O. I. Smoktii (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 505-514. 11 refs.

Results are given of spectrophotometric measurements of natural formations performed with the help of the handheld spectrograph RSS-2 installed on the 'Soyuz-9' spacecraft. Comparison is made with the data of the surface spectrophotometric measurements. (Author)

A73-39859 * # Airborne infrared polarimetry. D. L. Coffeen (Arizona, University, Tucson, Ariz.) and J. E. Hansen (NASA, Goddard Institute for Space Studies, New York, N.Y.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1.

Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 515-522. NASA-supported research.

An airborne remote sensing study of cloud particle sizes and shapes, performed with an IR polarimeter is described. Linear polarization for a given wavelength was measured as a function of the phase angle. Liquid water clouds are found to exhibit considerable detail in their polarization curves, including a positive cloudbow near 40-degrees phase angle, and negative polarization at phase angles of less than 20 degrees and greater than (roughly) 100 degrees. A polarization vs phase angle curve obtained for thick tropical cirrus clouds showed negative polarization at large and small phase angles, and positive polarization at angles between 20 and 145 degrees. There is no indication of a cloudbow or other detailed structure. V.P.

A73-39860 * # Principles and techniques of polarimetric mapping. J. Halajian and H. Hallock (Grumman Aerospace Corp., Bethpage, N.Y.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 523-540. 28 refs. Research supported by the Grumman Aerospace Advanced Development Program; Contract No. NAS9-12963.

This paper introduces the concept and potential value of polarimetric maps and the techniques for generating these maps in operational remote sensing. The application-oriented polarimetric signature analyses in the literature are compiled, and several optical models are illustrated to bring out requirements of a sensor system for polarimetric mapping. By use of the concepts of Stokes parameters the descriptive specification of one sensor system is refined. The descriptive specification for a multichannel digital photometric-polarimetric mapper is based upon our experience with the present single channel device which includes the generation of polarimetric maps and pictures. High photometric accuracy and stability coupled with fast, accurate digital output has enabled us to overcome the handicap of taking sequential data from the same terrain. (Author)

A73-39874 # Remote sensing from an earth resource rocket. B. S. E. Beattie (British Aircraft Corp., Ltd., Bristol, England). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 777-787.

Description of the design and testing of a prototype earth resources rocket which is based on the well proven Skylark sounding rocket and was launched at the Woomera rocket range in Australia on Mar. 27, 1972. After reviewing the characteristics of the original Skylark rocket, the modifications introduced into the earth resources rocket prototype (the SL 1081) are indicated. While the motor combination - Goldfinch boosted Raven 6 with its triple fin assembly and ignition unit - is a normal Skylark configuration, the payload section possesses a number of new features, including the attitude control system (which employs two earth albedo horizon sensors) and the roll rate control unit which operates during the Raven motor burn period. Two cameras were mounted on board the rocket - an F24, which approximates the present standard 115-mm format, and a Hasselblad 500, selected mainly on account of the wide range of lenses available. A.B.K.

A73-39903 # A comparison of four remote sensing media for assessing salt marsh primary productivity. J. L. Gallagher, R. J. Reimold (Georgia, University, Sapelo Island, Ga.), and D. E. Thompson (MAPCOTec, Inc., Daytona Beach, Fla.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2.

Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 1287-1295. 8 refs. NSF Grant No. GA-29446.

Comparison of three types of photographic films with the technique of scanning infrared imagery for assessing salt marsh primary production over large areas. Factors such as ability to discern species, relationship of image to ground truth, sharpness of pattern, excess or deficiency of information, cost, usefulness of format, weather and light conditions required, and accuracy of quantification were considered. Photographic imagery was obtained with Kodak Aerochrome Infrared, Ektachrome MS Aerographic, and Kodak Infrared Aerographic films. Nonphotographic imagery was obtained with a Bendix Thermal Mapper LN-3. Four windows within the 2.0- to 13.0-micron wave band were examined. All photography and scanning imagery were done from fixed-wing aircraft to yield scales from 1:2500 to 1:40,000. (Author)

A73-39909 # ERTS-1 image quality. R. Welch (Georgia, University, Athens, Ga.). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 2. Ann Arbor, Mich.,

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Environmental Research Institute of Michigan, 1973, p. 1411-1423. 13 refs.

Comparative study of the imaging capabilities of the ERTS-1 satellite return-beam vidicon (RBV) cameras and multispectral scanner (MSS). Subjective and objective evaluations of image quality are made which include the determination of response functions, resolving power, measurability and detectability of small detail, and the influence of image motion. On the basis of an analysis of a limited sample of simulated and operational images, it is concluded that the ERTS-1 RBV cameras and MSS are producing pictures of similar quality. At a scale of one to one million, a resolution value of about 4 lines per mm is indicated, which is equivalent to a ground resolution of approximately 250 meters. A.B.K.

A73-40814 # On radio science techniques for remote sensing. J. W. Rouse, Jr. (Texas A & M University, College Station, Tex.). *COSPAR, Planary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper*. 13 p. 26 refs.

This paper presents examples of radio techniques for remote sensing which have evolved from activities within URSI. The application areas discussed include remote sensing of Polar regions and remote determination of soil characteristics, specifically, moisture content. The electromagnetic backscatter and depolarization by ice and terrain are reviewed, and the problem areas needing additional effort are identified. Remote sensing by both active (radar) and passive (microwave and thermal infrared) sensors are considered, and the role of radio science techniques in the future development of orbital remote sensing is described with specific reference to the Skylab and ERTS-B missions. (Author)

A73-41521 * # ERTS-1 - Teaching us a new way to see. E. P. Mercanti (NASA, Goddard Space Flight Center, Greenbelt, Md.). *Astronautics and Aeronautics*, vol. 11, Sept. 1973, p. 36-63, 65-68.

The ERTS-1 payload is discussed, giving attention to three television cameras, which view the same area in three different spectral bands. The payload includes also a multispectral scanner subsystem and a data collection system which collects information from some 150 remote, unattended, instrumented ground platforms. Many government agencies use ERTS-1 data as integral parts of their ongoing programs. Through its EROS program, the Interior Department represents the largest single recipient and user agency of data obtained from NASA aircraft and spacecraft designed to gather repetitive information related to a wide variety of earth-science and natural-resources disciplines. Questions of environmental impact are considered together with applications in agriculture, forestry, marine resources, geography, and the survey of water resources. G.R.

A73-41574 Atmospheric thermal emission 2.5-4.2 microns. A. W. Harrison (Calgary, University, Calgary, Alberta, Canada). *Boundary-Layer Meteorology*, vol. 5, July 1973, p. 365-372. 7 refs.

A simple digital recording near-infrared spectrometer has been used to obtain intensity-calibrated thermal emission spectra of the lower atmosphere between 2.5 and 4.2 microns under a variety of atmospheric conditions. In particular, the nu-1 HDO band at 3.7 microns has been observed at 100 Å spectral resolution. The usefulness of the instrument for measuring thermal emission out to 7 microns and for detecting pollutants is also discussed. (Author)

A73-41925 * Satellite ultraviolet measurements of nitric oxide fluorescence with a diffusive transport model. D. W. Rusch (Colorado, University, Boulder, Colo.). *Journal of Geophysical Research*, vol. 78, Sept. 1, 1973, p. 5676-5686. 27 refs. Contract No. NAS5-9315.

Twilight measurements of fluorescence in the (1, 0) gamma band of nitric oxide were made from June 1967 to January 1969 by an ultraviolet scanning spectrometer on board the polar orbiting satellite Ogo 4. Nitric oxide vertical column emission rates were measured between solar zenith angles of 93 and 98 deg. Seasonal and latitudinal variations were found to be less than a factor of 1.3, the

scatter and uncertainty in the data prohibiting more precise determinations from being made. Time independent chemical diffusion models for the vertical distribution of nitric oxide agree well with profiles measured from sounding rockets. The column emission rates calculated from the theoretical models are larger than the satellite measurements by a factor of 3. (Author)

A73-41976 Symposium on Temperature, 5th, Washington, D.C., June 21-24, 1971, Proceedings. Part 1 - Basic methods. Scales and fixed points. Radiation. Part 2 - Resistance, electronic and magnetic thermometry. Controls and calibration. Bridges. Part 3 - Thermocouples. Biology and medicine. Geophysics and space. Symposium sponsored by the American Institute of Physics, Instrument Society of America, and National Bureau of Standards. Edited by H. H. Plumb (National Bureau of Standards, Boulder, Colo.). Pittsburgh, Instrument Society of America (Temperature, Its Measurement and Control in Science and Industry. Volume 4. Parts 1, 2 & 3), 1972. Pt. 1, 735 p.; pt. 2, 728 p.; pt. 3, 866 p. Price of three parts, \$110; \$40.

Background information is given on the origin, development, and use of the 1968 International Practical Temperature Scale. Other temperature scales, methods, and applications are detailed and compared; and standards, values, methods, and instrumentation in radiation thermometry are outlined. Low temperature sensing and applications, and techniques in resistance thermometry are discussed. Procedures and developments in electronic thermometry, temperature control, and calibration are examined. The use of computers and instrumentation for resistance thermometry is investigated. Areas of thermocouple use with reference to standards, properties, special techniques, performance, and use in nuclear environments are considered. Aspects of temperature dealing with biology, medicine, geophysics, meteorology, and astrophysics are treated. Individual items are announced in this issue. F.R.L.

A73-42062 Spectroscopic measurement of upper atmospheric temperature. G. G. Shepherd (York University, Toronto, Canada). In: Symposium on Temperature, 5th, Washington, D.C., June 21-24, 1971, Proceedings. Part 3. Pittsburgh, Instrument Society of America, 1972, p. 2313-2327. 73 refs. Research supported by the National Research Council of Canada.

The remote sensing nature of auroral and airglow spectroscopy offers the capability of deducing upper atmospheric temperatures from observations made at ground level. Before rockets and satellites this was one of the very few methods available. Even now, advances in the techniques, coupled with natural advantages, continue to make the method important. The physics of rotational and Doppler temperatures, and their application to the atmosphere, are described along with the spectroscopic devices employed. The familiar grating spectrometer can be used for some of these measurements, but for others the more specialized Fabry-Pérot spectrometer or Michelson interferometer is required. These devices are described in some detail. (Author)

A73-42729 A direct comparison of satellite and aircraft infrared /10 to 12 microns/ remote measurements of surface temperature. C. M. R. Platt and A. J. Troup (Commonwealth Scientific and Industrial Research Organization, Div. of Atmospheric Physics, Aspendale, Victoria, Australia). *Remote Sensing of Environment*, vol. 2, no. 4, 1973, p. 243-247. 8 refs.

Nimbus IV Satellite THIR (10 to 12 microns) sea surface temperature data for a region off the northeast coast of Australia were compared with data taken over the same region and period with a radiometer detecting in the same spectral interval flown aboard a DC-3 aircraft at altitudes ranging from the surface to 3 km. When the aircraft ascended from the surface to above the tradewind inversion, the apparent sea surface temperature decreased by 2.6 C, on average. An empirical formula for the water vapor absorption coefficient, which included a component proportional to the water vapor pressure, was used successfully to account for the apparent tempera-

ture decrease. From above the inversion, the aircraft radiometer sea surface temperatures were slightly greater than the Nimbus IV THIR sea surface temperatures. This discrepancy was accounted for by residual water vapor between the inversion and the tropopause, nadir angles of viewing from Nimbus IV, and the slight mismatch between the spectral filters of the two instruments. (Author)

A73-43330 Studies of the natural environment from manned orbital stations (Issledovaniia prirodnoi sredy s pilotiruemykh orbital'nykh stantsii). Edited by K. Ia. Kondrat'ev. Leningrad, Gidrometeoizdat, 1972. 410 p. In Russian.

Results of visual, photographic, and spectrophotometric observations of the earth from manned orbital spacecraft are surveyed and interpreted from general viewpoints of practical problems and overall significance. Daytime, nighttime, and twilight horizon observations which led to the discovery of the vertical-ray structure (horizontal inhomogeneity) of daytime emission from the upper atmosphere are of particular importance. Data from the Soiuz series spacecraft are examined in an evaluation of the feasibility of satellite picture interpretation for the benefit of geology, geomorphology, geobotany, hydrology, and other earth sciences. The use of spectrophotometry in atmospheric aerosol (twilight aureole) studies is discussed along with the identification of natural features from their reflection spectra. Simultaneous aircraft imagery experiments and the determination of the atmospheric transfer function are discussed.

T.M.

A73-43332 # Photography of the earth from space (Fotografirovanie zemli iz kosmosa). G. T. Beregovoi, B. V. Vinogradov, G. B. Gonin, O. N. Lebedev, and V. P. Stetsiura. In: Studies of the natural environment from manned orbital stations. Leningrad, Gidrometeoizdat, 1972, p. 67-181. 53 refs. In Russian.

Various environmental and flight-dynamics factors which influence photography of the earth's surface from space are examined along with the principles of space photogrammetry, methodological aspects of photographic imagery processing, interpretation of satellite photos in studies of the natural environment, and practical significance of photographic resource surveys. Attention is given to the use of ballistic information when taking photographs from space, influence of spacecraft orientation on the relative inclination of the photographic image to the earth's surface, illumination and meteorological conditions, details of cameras and film development processes, and the tying in of space photographs. Geographical, geological, geomorphological, and hydrometeorological interpretation of satellite photographs is described.

T.M.

A73-43333 # Spectrophotometric investigations of the earth from manned orbital stations (Spektrofotometricheskie issledovaniia zemli s pilotiruemykh orbital'nykh stantsii). A. A. Buznikov, O. B. Vasil'ev, V. N. Volkov, K. Ia. Kondrat'ev, V. I. Sevast'ianov, O. I. Smoktil, and E. V. Khrunov. In: Studies of the natural environment from manned orbital stations. Leningrad, Gidrometeoizdat, 1972, p. 183-384. 99 refs. In Russian.

Survey of the main results of spacecraft-based spectral brightness measurements of the atmosphere and of various types of underlying surfaces. Spacecraft spectral data are compared with simultaneously obtained aircraft imagery in corresponding wavelengths. A transfer function theory is developed which makes it possible to reduce satellite measurements of the earth's spectral brightness to the level of the underlying surface. A classification of the spectra of various natural formations is proposed. It is shown that spectral data on the reflectance and other optical parameters of the underlying surface can permit fine-scale differentiation of natural features on the basis of spectral measurements from orbit.

T.M.

A73-43354 * Very-long-baseline interferometry techniques applied to problems of geodesy, geophysics, planetary science, astronomy, and general relativity. C. C. Counselman, III (MIT,

Cambridge, Mass.). *IEEE, Proceedings*, vol. 61, Sept. 1973, p. 1225-1230. 18 refs. NASA-supported research.

A73-45020 # Picture of the month - NOAA 2 scanning radiometer visual and infrared imagery received real-time over a 50,000-mile transmission link. H. W. Brandli, J. W. Oliver, and R. J. Estu (USAF, Air Weather Service, Patrick AFB, Fla.). *Monthly Weather Review*, vol. 101, June 1973, p. 538, 539.

ITOS D (NOAA 2) was launched on Oct. 15, 1972. Its scanning radiometer system is designed to transmit imagery below the satellite night and day. An example of the radiometer imagery is presented. The imagery is received in real time, gridded geographically, and interpreted meteorologically by Air Weather Service forecasters at Cape Kennedy. An example of a quick local area analysis that can be derived exclusively from the satellite data is also provided.

G.R.

N70-16407* # Michigan Univ., Ann Arbor. Infrared and Optics Lab.

FURTHER INFRARED SYSTEMS STUDIES FOR THE EARTH RESOURCES PROGRAM Final Report

J. Braithwaite, L. Larsen, and E. Work Dec. 1969 77 p refs (Contract NAS9-8381)

(NASA-CR-102111; WRL-2122-14-F) Avail: CFSTI CSCL 14B

This report discusses the development of design concepts and specifications for multispectral scanners for use from orbit as part of the Earth Resources Program. The performance of such scanners may be limited by component performance, by weight and power allocations, and by the data rates and bulks which can be returned to the ground. Some of the more critical of these factors have been examined in detail, and methods of dealing with them have been investigated. It is shown, for example, that a 7-channel scanner with a 200 ft ground resolution is feasible, but that the swath width would be limited to less than 20 miles unless telemetry bandwidths larger than those in current use are made available.

Author

N70-17428* # Ewen Knight Corp., East Natick, Mass. OPTIMIZATION OF MICROWAVE RADIOMETRIC SYSTEMS FOR EARTH RESOURCE SURVEYS Final Report

H. I. Ewen and A. H. Barrett Jun. 1969 177 p refs (Contract NAS12-2047)

(NASA-CR-86316) Avail: CFSTI CSCL 14B

Passive microwave sensing projects instrumentation, and techniques are discussed. Studies and analytical models are reviewed in the areas of oceanography and marine technology, geology and hydrology, geography and cartography, and agriculture and forestry. Present ground-based and aircraft measurements are described and instrument technology requirements are analyzed. Airborne parametric displays with attendant laborious data reduction requirements and ineffective use of aircraft flight time reduce this form of data display to minimal use. Aircraft imagery techniques are considered to be not optimum. It is suggested that an experimental investigation of the potential benefits of passive remote sensing be made, utilizing more direct participation by users in the planning and execution phases. It is felt that microwave antenna size requirements are incompatible with present-day jet and piston type aircraft, but are compatible with satellites. An engineering plan is outline for the development of instrument technology, based on the building-block approach.

N.E.N.

N70-17760* # Honeywell, Inc., Minneapolis, Minn. Aerospace Div.

ATTITUDE-REFERENCED RADIOMETER STUDY. VOLUME 2: PRECISION RADIOMETRIC SYSTEM

John R. Thomas, John C. Carson, William R. Williamson, Lester B. Florant, Herman P. Grienel et al Aug. 1969 656 p refs (Contract NAS1-8801)

(NASA-CR-66855) Avail: CFSTI HC \$10.00/MF \$0.65 CSCL 14B

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This volume documents those aspects of the Attitude-Referenced Radiometer Study devoted to advancing the techniques for the design, analysis, and fabrication of applicable radiometric systems and the overall ARRS system interface. In the system interface area a technique was developed for rapid and complete identification and determination of the effects on all ARRS subsystems of varying design or performance parameters in any one subsystem. The analysis tool developed for this function is the parameter variation checklist. A comprehensive generalized radiometer analytical model was developed to be used as a tool in the design, analysis, and evaluation of those radiometer configurations applicable to the ARRS radiometer performance goals. The analytical model describes propagation of external and internal signal, noise, and error through the radiometer and includes a description of the radiometer transfer function (spatial and temporal) signal processing, and ground data reduction. An operational Primary Calibration System concept was defined and the preliminary design of and engineering model completed. Author

N70-20048# Institute for Storm Research Inc., Houston, Tex.
FORECAST METHODS FROM SATELLITE PHOTOGRAPHS
Final Report, 1968-1969

John C. Freeman, Pieter Feteris, Sam Rosenberg, Keith Veigas, and Troxel Ballou Jun. 1969 62 p refs
(Contract N62306-68-C-0289)
(AD-697940; ISR-45) Avail: CFSTI CSCL 4/2

Two models of atmospheric flow, compensation and moist over-compensation are found to be useful in the study of tropical weather in conventional and satellite observations. A numerical weather prediction model simulating important physical processes in the low latitudes is developed to test the feasibility of using ATS information to infer future weather distribution. Diagnostic studies using ATS films and conventional synoptic weather maps describe the weather situations in the Central North Pacific in terms of the theoretical models. Results of the prediction experiment and future use of ATS type data in numerical prediction models are discussed and application recommended. Appendix A gives a description of one method of following cloud motion in satellite photographs. Author (TAB)

N70-20921*# Michigan Univ., Ann Arbor. High Altitude Engineering Lab.

HIGH ALTITUDE RADIATION MEASUREMENTS Quarterly Report, 1 Jul.-30 Sep. 1969

Fred L. Bartman Dec. 1969 19 p refs
(Contract NASr-54(03); ORA Proj. 05863)
(NASA-CR-109090; Rept-05863-27-P) Avail: CFSTI CSCL 04A

Problems in the analysis of interferometer data from the 20 November 1968 balloon flight were solved. High resolution measurements of the 15 micrometer CO₂ band with the 1.8 meter Jarrell Ash spectrometer were obtained; modifications to the instrument for this purpose are described which involved entrance and exit optics, and a connecting flange. A literature survey regarding the distribution of CO₂ in the earth's atmosphere is continuing and selected references are included. Author

N70-21145# Royal Aircraft Establishment, Farnborough (England).
SPATIAL SURVEILLANCE OF NATURAL RESOURCES

D. I. Raitt, comp. Jan. 1969 23 p refs
(RAE-LIB-BIB-308) Avail: CFSTI

This selective bibliography covers the period 1944 to date. In general the coverage is of the following fields: mineral deposits, agriculture (vegetation, crops, soils), forestry (disease, fire), wildlife, livestock and water resources. A select list of references on applications satellites is also included. Author

N70-21426*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PROCEEDINGS OF THE 4th AEROSPACE MECHANISMS SYMPOSIUM

George G. Herzl ed. and Mary Fran Buehler ed. 15 Jan. 1970 144 p. refs. Conf. held at Santa Clara, Calif., 22-23 May 1969 sponsored by Santa Clara Univ., JPL, and Lockheed Missiles and Space Co.

(Contract NAS7-100)

(NASA-CR-109092; JPL-TM-33-425) Avail: CFSTI CSCL 22B

Design principles, details, and applications with which the aerospace mechanism designer must be familiar are discussed.

N70-21871# Telcom, Inc., McLean, Va.
GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITE (GOES) DATA COLLECTION SYSTEM. TASK 3. DESIGN, ASSEMBLY, AND INTEGRATION OF DEMONSTRATION GROUND TERMINALS. TASK 4. SATELLITE DATA COLLECTION TEST AND DEMONSTRATION PROGRAM Final Report

Dec. 1968. 159 p refs

(Contract ESSA-E-157-87(N))

(PB-187863; TER-157-0003) Avail: CFSTI CSCL 22B

The geostationary operational environmental satellite (GOES) system is designed to provide environmental data collection and dissemination and emergency warning services. Under the control of a CDA (control and data acquisition) ground terminal, the GOES will relay interrogation signals to a variety of remote sensor terminals, including buoys, river gauges, seismic sensors, and remote weather stations. These sensor terminals will automatically respond with a data message which will be relayed by GOES back to the CDA. Computing facilities associated with the CDA will perform such analysis and tabulation as required, then disseminate the data to users, either through GOES or by other communications links. Another function of the GOES is that of taking large scale pictures of the earth with the spin-scan camera system. Author (USGRDR)

N70-22497# Deutsches Geodaetisches Forschungsinstitut, Munich (West Germany).

SATELLITE OBSERVATION BY MEANS OF THE BC-4 BALLISTIC CAMERA [SATELLITENBEOBACHTUNG MIT DER BALLISTISCHEN KAMERA BC-4]

E. Wolf In DVFLR On the Location of Satellites by Means of Lasers and Their Appl. in Various Fields Oct. 1969 p 30-36 In GERMAN

Avail: CFSTI

The use of a Wild BC-4 ballistic camera for satellite triangulation and geodesy is described. The parameters taken into account in the data reduction are described. ESRO

N70-22676* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
APOLLO 9 MULTISPECTRAL PHOTOGRAPHIC INFORMATION

John L. Kaltenback, comp. Washington Apr. 1969 38 p refs
 (NASA-TM-X-1957; S-228) Avail: CFSTI CSCL 14E

The NASA Experiment SO65, multispectral photography flown on the Apollo 9 mission provided orbital photography of the earth. The photography was taken by four cameras, each of which contained a different film-filter combination. Special color viewing and reproduction systems are being used to determine the use and value of multispectral photography to the earth resources disciplines and to apply these findings to the design of future imaging systems.

Author

N70-22988* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ATS-E MAGNETIC FIELD MONITOR INSTRUMENTATION

T. L. Skillman Jan. 1970 34 p refs

(NASA-TM-X-63852; X-645-70-54) Avail: CFSTI CSCL 14B

Instrumentation, tests and calibration, and data outputs of the magnetic field monitor (MFM) are described. The position of the MFM sensor and electronics package on the ATS-E spacecraft, and the fluxgate magnetometer coordinate system are illustrated. Rapid satellite spin rates and their effects on the telemetry outputs of the MFM are discussed. Four ground stations in Manitoba provide magnetograms for comparison with ATS-E data.

M.H.E.

N70-24086* Institut fuer Angewandte Geodäsie, Frankfurt am Main (West Germany).

A PRECISION EVALUATION OF THE ORTHO-PROJECTOR GIGAS/ZEISS [EINE GENAUIGKEITSUNTERSUCHUNG DES ORTHOPROJEKTORS GAS-ZEISS]

Herrmann G. Neubauer 1969 78 p refs In GERMAN Its Ser. No. 1

(Rept-42) Avail: CFSTI

Optical precision of the ortho-projector Gigas in reestablishing aerial strip photographs was evaluated by analyzing the following error sources: (1) operation error; (2) error in the surveying model; error connection between stereo-planigraph and ortho projector; (3) instrument error of ortho projector; (4) observer error; and (5) film error in ortho photos. It was shown that blurring increased proportional to depth of focus.

Transl. by G.G.

N70-26127* Massachusetts Inst. of Tech., Cambridge.

INSTRUMENTATION

In its The Terrestrial Environ. Apr. 1970 35 p refs (See N70-26126 12-13)

Avail: CFSTI CSCL 14B

The instrumental capabilities for geophysical observations are discussed in terms of accuracies, resolutions, lifetimes, averaging times, and power and weight requirements that appear attainable within the next 5 to 10 years to measure directions, ranges, range rates, altitudes, and accelerations. The separate needs of the various disciplines comprising oceanography and solid earth physics are reviewed as a basis for defining system objectives. A unified system of global observations of the earth sciences is proposed, and the general configuration of the system is described. The technology needed to support this system is examined to determine the specific functions that must be performed by each of the major system elements. Particular consideration is given to such

techniques as camera tracking, laser ranging, very long-baseline interferometry, satellite altimetry, drag-free satellite methods, satellite-to-satellite range rate, radio ranging, tropospheric and ionospheric propagation errors, epoch timing, and gravimeters and gradiometers. Specific areas where additional research and development are needed are identified.

M.G.J.

N70-26469* Joint Publications Research Service, Washington, D.C.

ANGULAR DISTRIBUTION OF REFLECTED RADIATION ON BASIS OF DATA OBTAINED DURING FLIGHTS OF AN IL-18 AIRCRAFT IN 1964

A. I. German et al 8 Apr. 1970 26 p refs Transl. into ENGLISH from Tr. Tsentr. Aerolog. Observ. (Moscow), no. 70, 1966 p 3-22 (JPRS-50267) Avail: CFSTI

The problem of the simultaneous study of cloud formations and radiation is considered. A method is described for conducting aircraft experiments and for processing the measurements of reflected short wave radiation from various underlying surfaces and cloud formations by using aerial photographs. The angular distribution of brightness coefficients and the intensity of the reflected radiation are shown in relation to the features of the underlying surface and the spatial structure of clouds of various shapes.

Author

N70-28484* Research Triangle Inst., Durham, N.C.

A STUDY OF THE CAPABILITIES OF THE GEODETIC SATELLITE ALTIMETER TO MEASURE OCEAN-SURFACE CHARACTERISTICS Final Engineering Report

Apr. 1970 184 p refs

(Contract NASw-1909)

(NASA-CR-110085) Avail: CFSTI CSCL 17I

The results of an eight-month study of signal processing techniques applicable to the Geodetic satellite altimeter program is presented. Analysis of random errors in the altitude measurement process which arise from signal fluctuations and receiver noise is discussed. Results are presented based on both theoretical analyses and computer simulation of the altimeter concept. Characteristics of the electromagnetic energy scattered from the ocean surface are then discussed from the standpoint of identifying statistical properties of the altimeter signal and for identifying measurement biases that may arise in the scattering process. A discussion of the presently known oceanographic factors pertaining to the scattering problem concludes the report.

Author

N70-28170* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

FIELD CALIBRATION OF THE RS-14 DUAL-CHANNEL AIRBORNE INFRARED IMAGER

Victor E. Whitehead Apr. 1970 23 p

(NASA-TM-X-58042) Avail: CFSTI CSCL 14B

The collection of data on the NASA Earth Resources Aircraft Program Mission 98 (Puerto Rico and Barbados) presented an opportunity to compare the output of the Barnes PRT-5 precision radiation thermometer and the RS-14 dual-channel airborne infrared imaging system aboard the NASA NP3A aircraft. The RS-14 as flown on Mission 98 was not a fully calibrated system. Inspection of the RS-14 output and comparison of the RS-14 data with the PRT-5 data suggest a simple calibration procedure for the RS-14. This calibration procedure indicates that very little error is introduced in the thermal channel because of the use of different

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parts of the optics during a scan and that the measured case temperature apparently is not a representative cavity temperature for the system. Author

N70-30415# Goodyear Aerospace Corp., Litchfield Park, Ariz.
PREDESIGN DATA FOR THE RADAR STEREO EQUIPMENT PROGRAM Interim Report
F. F. Miranda Aug. 1969 63 p
(Contract DAAK02-69-C-0265)
(AD-701169; GERA-1500: IR-1) Avail: CFSTI CSCL 17/9

The report describes the progress made during the first phase of the radar stereo equipment program. During this phase an analytical approach to stereo plotting was selected and a preliminary design of the equipment was developed. The selected approach involves a stereo comparator for making measurements on the imagery, a general purpose computer to transform image coordinates to map coordinates, and a digital plotter to plot the map contours. Also, a set of equations describing the stereo model was derived and an analysis performed. Author (TAB)

N70-32636# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANALYSIS OF RESULTS OF SPECTROPHOTOMETRIC MEASUREMENT OF THE CREPUSCULAR HALO OF TERRESTRIAL ATMOSPHERE FROM SOYUZ-5 SPACESHIP
K. Ya. Kondratyev et al 24 Feb. 1970 22 p refs Transl. into ENGLISH from the Russian
(AD-703547; FTD-MT-24-442-69) Avail: CFSTI CSCL 4/1

The analysis permits the estimate of optimum possibilities of using photographic and spectrophotometric measurement of crepuscular atmosphere from space ships to obtain the vertical profile coefficient of aerosol scattering. As was shown at small approach angles of the sun behind the horizon the vertical gradients of brightness of the crepuscular atmosphere are absent. With increase angle of the sun behind the horizon the intensity of scattered light decreases, and saturation of tones of the color picture decreases; on curves of monochromatic brightness there appear characteristic discontinuities and minima. During the solution of inverse problems of space atmospheric optics, colorimetric analysis of obtained optical data should be combined with the analysis of the amount of depression on curves of monochromatic brightness of the crepuscular halo, depending upon the volume concentration of aerosol at various heights, conditions of illumination of crepuscular atmosphere by direct solar radiation, geometry of sighting, and orbit height of the spaceship. Author (TAB)

N70-34166# Raytheon Co., Sudbury, Mass.
SPACE GEODESY ALTIMETRY: PULSE COMPRESSION RADAR STUDY
Washington NASA Jul. 1970 164 p refs
(Contract NASw-1709)
(NASA-CR-1605; R69-4346) Avail: CFSTI CSCL 171

A study was conducted to establish the applicability of pulse compression to satellite altimetry. Parametric trade offs were made and experimental results presented. The study concludes that if 10 cms measurement accuracy is to be achieved a pulse compression system can achieve it with less size, weight and power than can a system that relies solely on a short pulse for its accuracy. Author

N70-34410# TRW Systems Group, Redondo Beach, Calif.
EARTH RESOURCES TECHNOLOGY SATELLITE. VOLUME 2: ERTS SYSTEM STUDIES Final Report
17 Apr. 1970 281 p refs
(Contract NAS5-11260)
(NASA-CR-109912) Avail: CFSTI CSCL 22B

The results of Phase B/C studies of the ERTS system that encompass elements of both the observatory and the ground data

handling system, or that can affect factors in the program beyond these two systems are reported. Four specific studies are involved: (1) booster vehicle choice, (2) orbital analysis, (3) improving GDHS performance through observatory, and modifications (4) total system accuracy. Author

N70-34411# TRW Systems Group, Redondo Beach, Calif.
EARTH RESOURCES TECHNOLOGY SATELLITE. VOLUME 3: OBSERVATORY SYSTEM DESIGN Final Report
11 Feb. 1970 256 p
(Contract NAS5-11260)
(NASA-CR-109840) Avail: CFSTI CSCL 22B

The ERTS observatory as a reliable and versatile system capable of gathering information about the world's natural and cultural resources is described. It provides room and weight-carrying capability for installing a variety of sensors including specifically a multispectral point scanner, a triplet of return beam vidicon cameras and their associated electronics, a real time data collection system, and a pair of video tape recorders. It includes an attitude control system which provides accurate three-axis stabilization with the horizon and orbit plane as references and an attitude determination capability for refining knowledge of the relative and absolute location of image points. Power for continuous subsystem operation and for 20 minutes of payload operation has been included. Spacecraft monitoring and control and payload data readout can take place using either STADAN or MSFN ground stations. There is a high probability, 85 percent, that ERTS missions could continue unimpaired for three years. The ERTS design is a logical outgrowth of the OGO program and makes use not only of the technology and design developed but actually incorporates OGO spare parts in many instances. Author

N70-34413# TRW Systems Group, Redondo Beach, Calif.
EARTH RESOURCES TECHNOLOGY SATELLITE. VOLUME 5: DATA COLLECTION SYSTEM Final Report
11 Feb. 1970 265 p refs
(Contract NAS5-11260)
(NASA-CR-109911) Avail: CFSTI CSCL 22B

The data collection and transmission system and supporting analyses for ERTS phases B and C are documented. Results of four main investigations are discussed: (1) system concepts (including visibility time and coverage, message structure, error detection coding, link analysis, random emission capacity, radio frequency interference, platform deployment and power sources, antennas, and pulse repetition frequency); (2) hardware design (data collection platform, spacecraft receiver, and ground signal recovery); (3) message collision analysis (time domain, random emission multiple access with replication, dual random time and frequency mode, and computer simulation); and (4) data transmission to GSFC. Ground sensor data collection platform sites will process and transmit data to ERTS for relay to the ground via a unified S-band link for further relay and processing. E.C.

N70-34418# TRW Systems Group, Redondo Beach, Calif.
EARTH RESOURCES TECHNOLOGY SATELLITES. VOLUME 10: SOLDERING PROGRAM PLAN Final Report
11 Feb. 1970 70 p
(Contract NAS5-11260)
(NASA-CR-109921) Avail: CFSTI CSCL 22B

Basic principles are described for hand and machine soldering requirements for reliable electrical and electronic equipment. The supplier soldering program is briefly reviewed, along with the various facilities, equipment, and materials used in the different types of soldering. Soldering preparation, mounting, conductor attachment to terminals, terminal and printed wiring assembly soldering, and automatic soldering of printed circuit boards are also noted. J.A.M.

N70-34454*# General Electric Co., Philadelphia, Pa. Space Systems Organization.

EARTH RESOURCES TECHNOLOGY SATELLITE SPACECRAFT SYSTEM DESIGN STUDIES. VOLUME 1: SYSTEMS STUDIES Final Report

11 Feb. 1970 288 p

(Contract NAS5-11529)

(NASA-CR-109907; Doc-70SD4207-VOL-1) Avail: CFSTI CSCL 22B

The baseline spacecraft system design for the earth resources technology satellite is summarized, including spacecraft system design, hardware matrix, and a launch vehicle study. The spacecraft reliability assessment for examining the individual spacecraft subsystem designs and the orbit analysis for evaluating the spacecraft orbit adjust subsystem in terms of its functional capability, sizing, and operational features are reviewed, as well as image location and coverage, time annotation, mission simulation, and management.

J.A.M.

N70-37140 World Meteorological Organization, Geneva (Switzerland).

DEVELOPMENT OF THE WWW OCEANIC OBSERVING SUB-SYSTEM FOR 1972-1975

1970 107 p refs *Its World Weather Watch Planning Rept. No. 31*

Copyright. Avail: WMO, Geneva; Sw. Fr. 10

This report summarizes observational requirements as regards the accuracy, spacing and frequency of data to be effective during the period 1972-1975 for the World Weather Watch (WWW). The five types of vehicle for electron, and scanning electron microscopy were used to examine the topography of the films produced, and X-ray WWW are reviewed. This leads to a consideration of the integrated subsystem observing sub-system in which the following five components are further examined: (a) ships, (b) aircraft, (c) satellites, (d) superpressure balloons, (e) buoys. Requirements for the period 1976-1979 are also considered. Author (ESRO)

N70-37285# Royal Aircraft Establishment, Farnborough (England). **OBSERVATION LIMITS OF LOW POWER SPACEBORNE SIDE-LOOKING RADAR FOR EARTH RESOURCES APPLICATIONS**

S. L. Entres Jan. 1970 19 p refs

(RAE-TR-70015) Copyright. Avail: CFSTI

Some observational capabilities of orbiting side-looking synthetic aperture radar systems are evaluated. Two mean radar power levels are assumed available, 250 W and 500 W, and observation from 500 km and 1000 km altitude respectively is considered. A ground resolution distance of about 50 m associated with an observed strip about 100 km wide seems feasible though radar wavelengths required tend to become long. Author (ESRO)

N70-38940*# Block Engineering, Inc., Cambridge, Mass.

A MILLIMETER WAVELENGTH INTERFEROMETER SPECTROMETER Final Report

Geert Wyntjes and Neils O. Young [1966] 33 p ref *Its Tech. Letter NASA-15*

(NASA Order R-146; Contract USGS-13009)

(NASA-CR-75556) Avail: CFSTI CSCL 20F

A millimeter wavelength interferometer spectrometer was designed and theoretically evaluated for geological measurements. The design calls for the following performance characteristics: (1) bandwidth capability from 0.5 to 2 mm, and a rate of two scans per second; (2) a maximum resolution of 0.05/cm; and (3) a S/N per resolution element of approximately 150 for a 300 K black body source filling the f.o.v. and for an emissivity of 0.1. In addition, the instrument is to have a cryogenic detector and provisions for cryogenically cooling the optical system. Confidence is expressed that the fabrication of the instrument, called the bibath interferometer

spectrometer, is feasible and that the specifications cited can be realized in an operational instrument. It is felt that the bipath instrument will be particularly useful for broadband spectral studies, such as atmospheric absorption measurements, terrestrial studies, and extraterrestrial emission measurements. The instrument as designed will be compact, lightweight, and will have good vibration tolerance.

D.T.

N70-39307*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

PHASED ARRAY ANTENNAS FOR APPLICATIONS ON SPACECRAFT

A. Kampinsky and W. H. Kummer (Hughes Aircraft Co., Culver City, Calif.) Jul. 1970 39 p refs Submitted for publication

(NASA-TM-X-65325; X-110-70-282) Avail: NTIS CSCL 09E

Phased array antenna systems, now operating on spacecraft, are reviewed so as to reveal their basic techniques of beam formation, steering and receive/transmit (transponder) functions. Laboratory developmental antennas, designed for ultimate spacecraft flight qualification, are assessed in terms of the needs of communications, earth resources instrumentation, and area surveillance programs. Author

N70-40086# Air Force Cambridge Research Labs., Bedford, Mass.

REMOTE SENSING: SPECIAL REPORTS

Harald Svensson May 1970 23 p Transl. into ENGLISH from Forskning Och Framsteg (Sweden), no. 5, 1969 p 10-19

(AD-707824; AFCRL-70-0277; AFCRL-Trans-79) Avail: NTIS CSCL 14/5

The parts of the electromagnetic spectrum are discussed, with the type(s) of sensor(s) required to record energy in each part. A review is given of the classes of airborne (and satellite) remote sensor data which are available to geoscientists. Different types of remote sensor data are described and examples provided, including panchromatic, infrared, color, and color infrared aerial photography (Kullaberg, Sweden); multispectral aerial photography (with importance of optimum film/filter combination for specific phenomena); airborne thermal infrared imagery (Kullaberg, Sweden and Surtsey, Iceland); side-looking airborne radar (Tuskahoma Syncline, Oklahoma); and radio sounding of glacial ice (Antarctica). The projected future increase in amount of remote sensor data will require computer processing techniques, although man will serve the most important role in the analysis and use of remote sensor information of the earth's surface. Author (TAB)

N70-40310*# Geological Survey, Menlo Park, Calif.

POSSIBLE APPLICATION OF REMOTE-SENSING TECHNIQUES AND SATELLITE COMMUNICATIONS FOR EARTHQUAKE STUDIES

Robert E. Wallace and David B. Slemmons (Nevada Univ.) Jun. 1966 9 p Presented at 2d US/Japan Conf. on Res. Related to Earthquake Prediction, 8 Jun. 1966 *Its Tech. Letter NASA-41*

(NASA Order R-09-020-015)

(NASA-CR-76299) Avail: NTIS CSCL 08G

A variety of remote sensing techniques and instruments are under development and appraisal, including both passive and active types. They make use of energy ranging from radar and microwave wavelengths through the visible part of the spectrum to ultraviolet and X-ray. Some techniques depend upon spectral analysis of the radiant energy, some instruments produce imagery by scanning techniques, and a variety of special cameras produce more nearly conventional photography. Author

N70-41028*# Geological Survey, Washington, D.C.

GEOLOGIC INVESTIGATIONS OF REMOTE SENSING TECHNIQUES Final Report, FY 1966

W. D. Crater 21 Jul. 1966 21 p refs *Its Tech. Lett. No. 52*

(NASA Order R-09-020-011; NASA Order R-09-020-013; NASA

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Order R-09-020-015; NASA Order R-09-020-019)
(NASA-CR-76634) Avail: NTIS CSCL 08G

The administration, funding manpower, and report accomplishments for the year are reviewed. The types of investigations undertaken are described, including instrument design and feasibility studies, space data studies, field investigations, and coordination and evaluation of remote sensing techniques. Significant scientific results are reported in the areas of Nimbus infrared imagery, space photography, radar imagery, infrared investigations, and ultraviolet absorption and stimulated luminescence. General plans and recommendations are enumerated for FY 1967; a list of reports completed during FY 1966 is included. P.A.B.

N70-41107*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. MULTISPECTRAL REMOTE SENSING OF AN EXPOSED VOLCANIC PROVINCE

J. G. Quade (Nevada Univ.), P. E. Chapman (Nevada Univ.), P. A. Brennan (Nevada Univ.), and J. C. Blinn, III 15 Jun. 1970 43 p refs
(Contract NAS7-100)

(NASA-CR-113826; JPL-TM-33-453) Avail: NTIS CSCL 08G

During July of 1968 a mission was flown, for a second year, over a volcanic province at Mt. Lassen National Park, in support of the NASA Earth Resources Program. Day and night flights were completed with the following instruments operating satisfactorily: two 9-in. by 9-in. metric cameras with black and white and color IR film, an 8-14 micrometer IR scanner, four microwave radiometers operating at 8.9, 15.8, 22.2, and 34.0 GHz and a 13.3-GHz radar scatterometer. Four ground stations were manned during the flights to monitor ground temperatures and moistures. These data were used in conjunction with ground-based radiometers operating at 1.4, 9.3, 13.7, and 37.0 GHz. Prior to the overflights, extensive ground studies (terrametrics), utilizing standard geologic and geophysical techniques, were performed. Data from the aircraft and ground-based sensors are presented with the relative merits of each sensor discussed along with recommendations for their application. Author

N70-41202# Grumman Aircraft Engineering Corp., Bethpage, N.Y. Geo-Astrophysics Section.

OPTICAL REMOTE SENSING OF BIORESOURCES

W. G. Egan Aug. 1970 24 p refs Presented at the Natl. Symp. on Hydrobiol., Miami Beach, Fla., 24-27 Jun. 1970; sponsored by the Am. Water Resources Assoc.
(RM-482J) Avail: NTIS

Two classes of sensors are used, photographic and electronic. Photography is limited to uses where color contrasts are evident. Accurate objective color specification is limited by such control problems as: manufacture and storage, exposure development, and evaluation. Photometric accuracies of approximately 2 percent or better are indicated when precision calibration and control techniques are used by astronomers for photographic spectrophotometry. Infrared film is widely used for photographic remote sensing of earth resources, in applications ranging from hydrology and bioresources to forestry and agriculture. Interpretation of colors may be made by using Munsell color standards or objectively by spectrophotometry. Colors are meaningless, however, unless a careful calibration program supplements the photography. An approach to remote sensing that uses all the optical information contained in scattered light appears to offer increased accurate characterization of earth resources. This information is embodied in Stokes parameters. The first Stokes parameter describes the brightness; the second, the relative polarization; the third, the plane of polarization; and the fourth, the circular polarization. Techniques have been evolved to sense remotely the Stokes parameters of water and land environments are described. This approach appears to permit identification of bioresources below the resolution limit for a given set of hardware. Author

N70-42682*# Texas A&M Univ., College Station. Remote Sensing Center.

RADAR SCATTEROMETER DATA ANALYSIS

John W. Rouse, Jr. May 1969 24 p refs Sponsored in part by Raytheon Co.

(Grant NGL-44-001-001)

(NASA-CR-110831; RSC-01) Avail: NTIS CSCL 08B

Mission 73 of the NASA/MSC earth resources aircraft program was flown over selected sites in Southern California to satisfy objectives within the disciplines of geology, geography, forestry, and hydrology. Included among the several remote sensors employed in the study was a Ryan Redop 2.25 cm wavelength radar scatterometer. Previous experiments with this sensor has confirmed its applicability to determination of sea state and differentiation of Arctic ice type. Earlier NASA/MSC Missions have employed the Ryan system to record backscatter energy from terrain, however, these data have not been analyzed. The described research constitutes an engineering experiment to determine the geoscience application areas of this sensor by evaluating its performance over specific, documented regions. Author

N70-43121*# Texas A&M Univ., College Station. Remote Sensing Center.

ANALYSIS AND EVALUATION OF A FORWARD VIEWING SCANNING RADAR SCATTEROMETER SYSTEM

Richard Harrison Arnold (M.S. Thesis) Aug. 1970 138 p refs

(Grant NGL-44-001-001)

(NASA-CR-110866; RSC-14) Avail: NTIS CSCL 17I

A scanning scatterometer which integrates for 0.2 second the returning signal from a terrain element defined by a minimum Doppler frequency difference of 280 Hz was investigated to determine whether the allowed integration time is sufficient for a given terrain element size for an accurate determination of the scattering coefficient, and to develop methods for improving the measurement accuracy without altering the basic scanning technique. The scatterometer is analyzed by system subassemblies: transmission, reception, signal reduction and logic, recording, and CRT display. Possible klystron transmission frequency drift problems and potential calibration problems are discussed. The calibration system is analyzed with respect to system operations. An alternative system is presented and shown to be equal to or better than the proposed calibration system. Author

N71-10348*# East Tennessee State Univ., Johnson City. Remote Sensing Inst.

THE FEASIBILITY OF USING REMOTE SENSORS FOR GEOGRAPHIC RESEARCH Final Report

Robert W. Peplies May 1970 74 p refs Sponsored by NASA

(Contract N00014-67-A-0102-0001)

(NASA-CR-111109; AD-707815; FR-1) Avail: NTIS CSCL 08F

The project had as its purpose the evaluation of remote sensor returns for use as data sources for geographic research. Test site 46, which is a 50 mile long, 10 mile wide strip oriented generally northwest-southeast from the Tennessee-North Carolina state line near Hot Springs, over Asheville, to the vicinity of Hendersonville near the North Carolina-South Carolina state line, was established as a region for periodic sampling by remote sensors and subsequently evaluating the utility of using such returns as data sources or contributory information sources for solution of certain geographic problems. Author (TAB)

N71-10652*# International Business Machines Corp., Gaithersburg, Md. Federal Systems Div.

INTERFEROMETER POSITION LOCATION CONCEPT. PHASE RECOVERY AND CALIBRATION, PHASE 2 Final Report

Oct. 1970 96 p refs

(Contract NAS5-21043)

(NASA-CR-111137; FSC-70-5269) Avail: NTIS CSCL 20F

Laboratory tests were performed on phase recovery and calibration techniques for a position location interferometer using low power emitters. A phase recovery technique was developed which uses a phase-locked loop and narrow-band filtering (60 Hz). Measurements made with this equipment integrated with the breadboard interferometer that was built for ATS F&C indicate a phase stability due to instrumentation of 0.2 electrical degrees (3 sigma). Space angle measurement tests were made using the 26.6 wavelength breadboard interferometer in an anechoic chamber. A 3 sigma accuracy of 0.01 mechanical degree was achieved over a 15-degree range of interferometer orientation. With a 400-wavelength interferometer, a position location error contribution of 0.2 km (1 sigma) would result from synchronous altitudes.

Author

N71-11164* Hulbert (E. O.) Center for Space Research, Washington, D.C.

PASSIVE MICROWAVE STUDIES

James P. Hollinger / In NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 3 1969 12 p refs

Avail: NTIS CSCL08J

The results of the Argus Island Tower measurements over a range of incidence angles and for a range of sea states are summarized as follows: (1) the general forms of the dependence of vertical and horizontal components of the brightness temperature of the sea on incidence angle are given by simple calculations; (2) vertical component is independent of sea state between about 50 to 60 degrees incidence angle; (3) vertical component increases below and decreases above about 55 degrees incidence angle with increasing sea state; (4) horizontal component increases with increasing sea state; (5) polarization decreases with increasing sea state at a rate which increases with increasing incidence angle; (6) foam greatly enhances the emissivity of the sea; and (7) the surface disturbance due to rain has much less effect on the emissivity of the sea than does foam.

Author

N71-11168* Philco-Ford Corp., Palo Alto, Calif. SRS Div. EXPERIMENTS IN OCEANOGRAPHIC AEROSPACE PHOTOGRAPHY: BEN FRANKLIN SPECTRAL FILTER TESTS

D. S. Ross and Reece C. Jensen / In NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 3 1969 32 p

(Contract N62306-69-C-0072)

Avail: NTIS CSCL08J

The spectral region of primary interest for oceanographic remote imaging sensors occurs within a passband approximating 400 to 580 millimicron. This includes the region of least light attenuation in clear water and a large percentage of coastal waters, where maximum depth penetration is possible and significant changes in upwelling luminosity occur. The practice in black-and-white aerial photography however is to reject image light at wavelengths shorter than 500 millimicron in order to suppress effects of atmospheric haze. Four-band multispectral photography with red, green, blue, and blue-green filters—taken on flights over a submersible when on the surface and at 10, 15, and 25 meters in the Gulf Stream—produced data confirming the utility of a blue filter band for oceanographic purposes. In addition, the results of the photographic evaluation were confirmed by measurements of the downward spectral irradiance made from within the submersible using a scanning spectroradiometer.

Author

N71-11421* Toronto Univ. (Ontario). Inst. of Aerospace Studies. STUDY OF THE BARRINGER REFRACTOR PLATE CORRELATION SPECTROMETER AS A REMOTE SENSING INSTRUMENT

Millan M. Millan, Stanley J. Townsend, and John Davies (Barringer

Research Ltd.) Aug. 1970 100 p refs Supported in part by Natl. Res. Council Revised

(Contracts NAS9-9492; PH-22-68-44; Proj. Optics 912)

(NASA-CR-111373; UTIAS-146-Rev) Avail: NTIS CSCL 20F

A theoretical study of the Barringer refractor plate correlation spectrometer is made, and several applications of the sensor are considered for the remote sensing of pollutant gases in the atmosphere. The instrument is intended to detect and measure the amount of a specified gas present between a suitable light source and the sensor. The technique used is that of correlation spectroscopy which is based upon the measurement of the degree of similarity between the molecular absorption spectrum of a chosen gas and the actual total absorption spectra of all the gases seen by the instrument. The mechanical and electrical characteristics of the instrument are described, and an analysis is performed of the optical characteristics of the instrument. The interactions between the characteristics of the light source irradiating the gas, the transmission spectrum of the instrument, the transmission spectrum of the correlation mask and the electronic circuitry are discussed. The application of the instrument to the remote sensing of pollutants in smokestack plumes and to the remote sensing of ground-covering atmospheric pollutants from a balloon-supported platform is discussed.

Author

N71-11984* Michigan Univ., Ann Arbor. Willow Run Labs.

MULTISPECTRAL DATA COLLECTION AND INSTRUMENTATION STUDIES

D. S. Lowe / In NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 2 1969 13 p refs

Avail: NTIS CSCL 20F

Two programs involving multispectral data collection and infrared instrumentation studies are discussed. The C-47 multispectral aircraft used in the studies carries optical mechanical scanners capable of simultaneous collection of imagery in as many as 19 wavelength bands. The various methods of data collection and the results of the program are summarized in tabular form.

R.B.

N71-11986* Michigan Univ., Ann Arbor.

NASA SUPPORTED REMOTE SENSING ACTIVITIES AT THE UNIVERSITY OF MICHIGAN WILLOW RUN LABORATORIES Annual Report, Sep. 1969

M. R. Holter / In NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 2 1969 36 p ref

Avail: NTIS CSCL08F

Research progress is reported on remote sensor data processing, interpretation, and utilization. The data is derived from remote sensing in the ultraviolet, visible, infrared, passive microwave, and radar portions of the spectrum, as well as acoustic and seismic techniques. Illustrative examples are given of recognizing wheat crops at different altitudes and times of the year, of reducing the effects of cloud shadows by preprocessing techniques, and participation in the SO-65 experiment over the Imperial Valley in California. It is recommended that sampling at frequent intervals during diurnal and seasonal cycles be conducted, with more adequate ground truth and calibration, at least two years prior to ERTS operation.

R.B.

N71-11987* Arizona Univ., Tucson. Optical Sciences Center.

USE OF PASSBAND INTERFERENCE FILTERS IN MULTISPECTRAL PHOTOGRAPHY

Philip N. Slater and Dean B. McKenney / In NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 2 1969 18 p refs

(Contracts NAS9-7081; F04695-67-C-0197)

Avail: NTIS CSCL 71H

A type of interference filter is described which can readily be designed for any central wavelength (400 to 900 nm) and any passband width (50 to 350 nm). The filters provide sharper cutoffs

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and greater efficiency than conventional absorption filters, and total transmittance in the required passbands, is shown to be 2 or 3 times greater, resulting in shorter exposure times and about a twofold increase in spatial resolving power for early space multiband photography experiments. The passband interference filters deposited on flat glass plates can be used to replace conventional absorption filters for lenses of less than 40 deg field of view. For larger angular fields the passband changes in shape and wavelength position. However, by uniformly depositing the filter on a selected lens surface, it is shown that the changes in shape and wavelength position can be greatly reduced for some modern wide-angle aerial lenses. Author

N71-11988* Long Island Univ., Greenvale, N.Y.
MULTISPECTRAL VIEWERS

Edward Yost *In* NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 2 1969 28 p refs

Avail: NTIS CSCL 17H

Multispectral additive color viewing devices are considered as a practical method for extracting useful information from sets of multiband photography. It is shown that such photography must be of exceptional quality in that the spatial positioning of all images with respect to their principal points must be accurate. Good correspondence is also required between the image densities on all the multispectral photography and the quantity of radiation reflected by an object in that particular spectral band. Author

N71-11989* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MICROWAVE STUDIES AND INSTRUMENTATION FOR THE EARTH RESOURCES PROGRAM

John C. Blinn, III *In* NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 2 1969 3 p

Avail: NTIS CSCL 17I

Progress is reported on a program to obtain data for calibration of aircraft microwave radiometers, to determine the microwave penetration depth of various materials, to examine the effects of particle size on microwave emission, and to examine the effects of water content on microwave emission. Other field measurement programs include reduction and analysis of data gathered over water, salines, limestone, and sand, and multifrequency radiometric data on various states of the ocean surface. Airborne measurements include microwave radiometry, radar-radiometry for simultaneous active and passive information, and a long-wave imaging radar. R.B.

N71-11990* Nevada Univ., Reno. NASA Project Office.
GROUND TRUTH/SENSOR CORRELATION

Peter Chapman, Jack Quade, Peter Brennan, and John C. Blinn, III (JPL) *In* NASA. Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 2 1969 28 p refs

Avail: NTIS CSCL 17H

The NASA 926 aircraft overflew a ground test site to examine remote sensing applications on simple geologic features. Data were taken by four-channel microwave radiometers, supported by radar scatterometers, thermal infrared imagers, and color infrared photography. During the overflight, intensive ground measurements of the thermal and physical characteristics of the materials at the test site were conducted. The usefulness of various photographic techniques as an aid to interpretation of long wavelength sensor data is discussed. The experiments show that multifrequency microwave techniques permit differentiation of materials on the basis of density, thermal characteristics, and surface roughness. Author

N71-11992* Geological Survey, Washington, D. C.
RECENT PROGRESS IN TANK, SHIPBOARD, AND HELICOPTER TESTS OF THE FRAUNHOFER LINE DISCRIMINATOR

George E. Stoertz and William R. Hemphill *In* NASA.

Manned Spacecraft Center 2d Ann. Earth Resources Aircraft Program Status Rev., Vol. 2 1969

30 p refs

Avail: NTIS CSCL 20F

The Fraunhofer line discriminator (FLD) is described as an experimental optical instrument for detecting substances that fluoresce near the sodium D2 Fraunhofer line (5890 Å). From an airplane, the FLD functions as an airborne fluorometer, quantitatively measuring the concentration of substances in the water that fluoresce near 5890 Å (yellow). The concentration of a substance is determined by using quantitative standards. Accurate quantitative measurements require ground-truth data: (1) the turbidity and temperature of the water column sensed by the FLD; and (2) the identity and approximate vertical distribution of the fluorescent substance. Laboratory experiments using tap water show that 1 part per billion (ppb) of Phodamine WT dye dissolved in 1/2 meter of water is detected. Shipboard and helicopter tests indicate the dye can be monitored in concentrations less than 5 ppb. Helicopter tests over relatively clear water suggest that 0.5 ppb can be detected. Fluorometer analysis of water samples collected simultaneously indicate that the FLD is accurate to about 5 percent for the range 1 to 50 ppb. Author

N71-12060* Long Island Univ., Greenvale, N.Y. Science Engineering Research Group.

NASA APOLLO 9 SO65 EXPERIMENT: MULTISPECTRAL TERRAIN PHOTOGRAPHY

Edward Yost, Robert Anderson, and Sondra Wenderoth 15 Jan. 1970 253 p refs

(Contract NAS9-9341)

(NASA-CR:108562; SERG-TR-13) Avail: NTIS CSCL 08F

A quantitative study of multispectral photography of the earth obtained from the SO65 experiment carried aboard Apollo 9 is reported. Analysis of the multispectral camera array showed sufficient spectral separation of each band, balance of photographic exposure, and relative spatial accuracy to allow additive color analysis of the imagery to be performed. Subsequently, a photographic reproprocessing technique was developed for use in conjunction with additive color viewing. Colorimetric study of these additive color renditions indicated they were significantly superior to color infrared films in identifying water, vegetation, soil, and crops. By comparison they had 10 times greater capability in discriminating subtle water detail. Spectroradiometric measurements of incident solar radiation and radiation reflected by the Willcox Playa were made and related to the SO65 multispectral photography taken at the same time. Computer analysis of the spectral data indicated that it is feasible to obtain quantitative relationships between the percent of directional reflectance of terrestrial objects in order to predict filter characteristics for optimum image formation from space sensors. E.M.C.

N71-12169* Akademiya Nauk USSR, Kiev.

SPECTROPHOTOMETRY OF THE EARTH FROM MANNED SPACECRAFTS (FROM THE DATA OF "SOYUZ 7" AND "SOYUZ 9")

K. Ya. Kondratyev, A. A. Buznikov, L. I. Chapursky, V. V. Gorbatko, A. A. Grigoryev et al [1970] 15 p refs Presented at the 21st Intern. Astronaut. Congr., Constance, West Ger., 4-10 Oct. 1970

Avail: NTIS

The results are presented of a program aimed at establishing accurate information about the earth's surface by correlating photography and spectrophotometry data obtained by manned spacecraft with similar data from aircraft instrumentation. The spectrography of the earth's surface from the Soyuz-7 and Soyuz-9 manned spacecraft was conducted in the nadir through an illuminator by means of a manual spectrograph. Aerial photography of the same region was made by IL-2 and IL-18 aircraft with instrumentation similar to that used on the Soyuz spacecraft. The data obtained are described and their significance is discussed. D.L.G.

N71-12711# Industriefanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).

SIMULATION OF MAGNETIC MAGNITUDES AND MEASUREMENT OF SPACECRAFT [SIMULATION MAGNETISCHER GROSSEN UND MESSUNG AN FLUGKÖRPERN]

P. Hertz *In* DFVLR Space Simulation for Satellites and Space Probes, Vol. 2 1970 21 p refs *In* GERMAN

Avail: NTIS

A magnetic field simulator, used for magnetic measurement of the Azur satellite, is described. The subsystems, such as coil system, power supply, and compensation unit for geomagnetic fluctuations, are explained. The methods used for measuring magnetic cleanliness, magnetic moments, as well as calibration of magnetometers, are discussed. ESRO

N71-12776# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

HOLOGRAPHIC INSTRUMENTATION APPLICATIONS

Boris Ragent and Richard M. Brown, eds. Washington 1970 249 p refs Conf. held at Moffett Field, Calif. 13-14 Jan. 1970 (NASA-SP-248) Avail: NTIS CSCL 14E

Selected papers are presented on application of holographic instrumentation to nondestructive testing, optical memory and data processing, measurement of small linear and angular displacements, study of fluid heat transfer phenomena, and wind tunnel flow visualization.

N71-12798# National Aeronautics and Space Administration. Wallops Station, Wallops Island, Va.

REVIEW OF HOLOGRAPHIC INSTRUMENTATION AT WALLOPS STATION

Frank E. Hoge *In its* Holographic Instrumentation Appl. 1970 p 239 refs

Avail: NTIS CSCL 14E

The application of holographic techniques to research in earth resources and geodetic altimetry is discussed. Techniques developed previously are to be applied in determining the surface wave energy spectra from photographs obtained from specially equipped aircraft. R.B.

N71-13089# Michigan Univ., Ann Arbor. High Altitude Engineering Lab.

THE MEASUREMENT OF ATMOSPHERIC OZONE USING SATELLITE INFRARED OBSERVATIONS IN THE 9.6 MICRON BAND

James Madison Russell, III (Ph.D. Thesis) Jul. 1970 160 p refs

(Contracts NSR-23-005-376; NASr-54(03); Grants NGR-23-005-394; ESSA-E92-69-N)

(NASA-CR-111566; Rept-03635-1-T) Avail: NTIS CSCL 04A

Two approaches to the measurement of ozone from a satellite using the 9.6 micron m band are analyzed; the nadir experiment and the horizon experiment. First, a technique is developed for inverting radiances measured in the nadir direction. A method is formulated for computing the emission from the lower boundary under the satellite which circumvents the difficult analytical problems caused by the presence of atmospheric clouds and the water vapor continuum absorption. The inversion equations are expanded in terms of the eigenvectors and eigenvalues of a least squares solution matrix and an analysis is performed to determine the information content of the radiance measurements. Next, a method is developed for inverting radiances measured in the horizon direction. The ensuing study proves the feasibility of the horizon experiment for determining ozone information and shows that the ozone partial pressure can be determined in the altitude range from 50 km down to 25 or 30 km. Author

N71-13311# Liege Univ. (Belgium). Inst. d'Astrophysique.

AN ON-BOARD POLYCHROMATOR FOR AURORAL STUDIES IN THE VISIBLE AND FAR UV DOMAINS [UN POLYCHROMATEUR EMBARQUABLE DESTINE AUX ETUDES AURORALES DANS LES DOMAINES VISIBLE ET UV LOINTAIN]

Robert Duysinx and Claude Jamar Paris ESRO Mar. 1970 29 p refs *In* FRENCH; ENGLISH summary

(ESRO-SN-111) Avail: NTIS

Spectroscopic studies of northern aurorae conducted from sounding rockets are made difficult by the fluctuating character of the light emission and the rocket motion. The use of several photometers, supplying continuous records of simultaneous emissions, allows precise correlations to be established, and helps unravel the dynamics of the mechanisms involved. The equipment comprised six photomultipliers working with a common dispersive unit so ensuring an identical viewing angle for all six detectors.

Author (ESRO)

N71-13474# Martin Marietta Corp., Denver, Colo.

PCM TELEMETRY FOR EARTH RESOURCES AIRCRAFT. END ITEM TEST REPORT, CONTRACT ITEM NO.1

Duane L. Starner Jun. 1969 76 p

(Contract NAS9-8146)

(NASA-CR-108700; MCR-69-286) Avail: NTIS CSCL 09F

Electrical and environmental qualification tests performed on the first PCM production system, and the acceptance testing of other system elements. Author

N71-13477# Martin Marietta Corp., Denver, Colo.

PCM TELEMETRY FOR EARTH RESOURCES AIRCRAFT. End Item Test Report; Contract Item Numbers 2, 3, and 7

Duane L. Starner Jul. 1969 7 p

(Contract NAS9-8146)

(NASA-CR-108701; MCR-69-376) Avail: NTIS CSCL 09F

The PCM Telemetry System consists of two basic units, the Control/Combiner Unit (CCU) and the Multiplexer Encoder Unit (MEU). A complete system is comprised of one CCU and up to four MEU's. The CCU provides the system timing signals and provides a flexible telemetry formatting capability via plug-in cards. Each MEU can accept 60 differential 0-5 volt analog signals which it converts to 10 bit binary words, and 60 differential bilevel signals grouped as six 10 bit words. The A/C conversion accuracy is +0.1%. The system was electrically tested to verify all specification requirements of the contract, including such tests as accuracy, input and output impedance, and frequency stability. The system was also subjected to vibration, temperature/altitude, and electromagnetic interference environments. Author

N71-14730# Sperry Rand Research Center, Sudbury, Mass.

DEVELOPMENT OF MARK 1 RADIOMETRIC THERMASONDE AND SIMULATION AND EXPERIMENTAL STUDIES FOR PASSIVELY PROBING TEMPERATURE STRUCTURE WITHIN THE FIRST MILE OF THE ATMOSPHERE Final Report, 1 Apr. 1968-21 Sep. 1969

W. D. Mount, A. C. Anway, C. V. Wick, C. M. Maloy, and R. Wilt 1969 115 p refs

(Contract PH-22-68-22)

(PB-192333; SRR-CR-70-6) Avail: NTIS CSCL 04A

Specifications for development of the Mark 1 radiometric Thermasonde (TM) are listed and performance characteristics are described. The paper, 'Use of Millimeter Wave Radiometry to Remotely Measure Atmospheric Stability,' presented at the Symposium on Advances in Instrumentation for Air Pollution Control, which describes work accomplished under this contract is appended. Simulated and experimental radiometric results are discussed for climatological and equipment effects in the observing of lapse, ground-based, and elevated inversions. A nonlinear nomogram was developed to correct for radiometric smoothing of intensity and height of ground-based inversions. Different observing modes and

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signal processing techniques assist in the interpretation of radiometric soundings for use in detecting elevated inversions. Author (USGRDR)

N71-15772# Joint Publications Research Service, Washington, D.C.

SOVIET AND BULGARIAN PHOTOGRAMMETRIC TECHNIQUES

4 Dec. 1970 25 p refs Transl. into ENGLISH from Geodez. i Kartograf. (Moscow), v. 14, no. 6, 1969 p 38 46, v. 14, no. 8, 1969 p 44 47; v. 14, no. 10, 1969 p 61 63 (JPRS-51920) Avail: NTIS

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1. ACCURACY IN SIGHTING AND IDENTIFYING POINTS WHEN MEASURING THEIR COORDINATES FROM AERIAL PHOTOGRAPHS N. M. Filchagin p 1 - 13 refs

2. PROCESSING AERIAL PHOTOGRAPHS ON PHOTOGRAMMETRIC INSTRUMENTS USING ADJUSTABLE VALUES V. B. Dubinovskiy et al p 14 18

3. UNIVERSAL SYSTEM FOR THE AUTOMATIC NUMERICAL CODING OF RESULTS OF PHOTOGRAMMETRIC MEASUREMENTS P. Zafirov p 19 23

N71-15841*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

NIMBUS 3 SATELLITE OBSERVATIONS OF OZONE ASSOCIATED WITH THE EASTERLY JET STREAM OVER INDIA DURING THE 1969 SUMMER MONSOON

C. Prabhakara, V. V. Salomonson, B. J. Conrath, J. Steranka, and L. J. Allison, Dec. 1970 26 p refs (NASA-TM-X-65416; X-651-70-464) Avail: NTIS CSCL 04A

Global distribution of ozone is remotely sensed from the radiance measurements made by the infrared interferometer spectrometer on board the Nimbus 3 satellite. As ozone is a good tracer of the atmospheric motions in the lower stratosphere and upper troposphere, it is used to infer the nature of upper air currents over southeast Asia and Africa during June and July, 1969. Significant ozone minima over North India, and the deserts of Sahara and Middle East correspond to upper air high pressure systems over these regions. Ozone maxima are seen preferentially along the path of the strong easterly winds associated with the easterly tropical jet. These observations of atmospheric ozone demonstrate a potentially valuable way to follow the development of the southwest monsoon and the tropical easterly jet stream. Author

N71-16133*# Florida Atlantic Univ., Boca Raton, Dept. of Geography.

INSTRUMENTATION OF IMAGE ANALYSIS AND TELEVISION SIMULATION TECHNIQUES

James P. Latham In NASA, Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 1 1968 29 p

Avail: NTIS CSCL 14B

Investigating concepts and electronic systems which discriminate and analyze geographic phenomena in imagery resulting from aerial and space sensor operations focused on one of three principal objectives: (1) the acquisition, evaluation, and interpretation of multisensor imagery which by time-series observations record the dynamic seasonal changes of the physical and cultural adaptations within a tropical and monsoonal test site in Florida; (2) the further development and testing of electronic instrumentation techniques that discriminate and sample or measure the geographic distribution of phenomena recorded in imagery and that can thereby provide some techniques for automatic interpretation; and (3) the simulation of orbital television observation of the surface of the earth, in order

to study how scale and scan-line rate changes affect the interpretation of geographic patterns in scan-line imagery. Author

N71-16143*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. AIRBORNE MULTIFREQUENCY MICROWAVE RADIOMETRIC SENSING OF AN EXPOSED VOLCANIC PROVINCE

John C. Blinn, III, Peter Chapman (Nevada Univ.), and Jack Quade (Nevada Univ.) In NASA, Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 1 1968 54 p refs Submitted for publication (JPL-TM-33-405) Avail: NTIS CSCL 08F

An empirical study was conducted, using airborne and ground-based sensors, to search for correlations between multispectral microwave brightness temperatures and geologic parameters. The test site was chosen because of its simple topography, large distinct areas of homogeneous composition, roughness characteristics, and lack of vegetation. Radiometers, operating at 9.3, 15.8, 22.2, and 34.0 gigahertz, were flown over preselected flight lines four times per flight to collect data. Results of the ground-truth studies and analysis of the aircraft overflights show a distinction between cinder and lava, two chemically similar materials with different surface characteristics. Results from an area of cinder layered over lava show a distinctive response, which may be related to cinder thickness. Author

N71-16145*# Kansas Univ., Lawrence, Center for Research in Engineering Science.

RADAR PROGRESS IN THE NASA EARTH RESOURCES AIRCRAFT PROGRAM

R. K. Moore In NASA, Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 1 1968 51 p refs

Avail: NTIS CSCL 08F

Design and performance of a 13.3-gigahertz scatterometer for measuring radar differential scattering coefficients is described and its application, together with an imaging radar for aerial sea-state measurements is outlined. The sea-state measurements provide a complete curve of scattering coefficient versus angle for each patch of sea relative independent of frequency for radar sea returns. Combined use of multifrequency radar scatterometers and imagers gives feasible frequency signature in the radar region. The processing of multispectral image data by computer is advocated and a real-time image discrimination enhancement and combination system is depicted. G.G.

N71-16146*# Michigan Univ., Ann Arbor.

INFRARED STUDIES

D. S. Lowe In NASA, Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 1 1968 17 p

Avail: NTIS CSCL 14B

The use of aerial infrared scanners for thermal mapping and multispectral scanning is advocated. Video signals from multiple detectors can be sampled to determine the spectral distribution of radiation from elements when the aircraft flies low over a terrain. Variation in reflectance with angle can be corrected by correlation with known spectral characteristics of objects and their backgrounds. Infrared imagery for earth resource applications requires a scanner to determine surface temperature on a quantitative basis; dc restoration in ac-coupled imaging systems provides fixed detector responses to sources of known radiance that can be quantified to produce true surface radiance as modified by atmospheric absorption and emission. Tonal distortions in infrared imagery caused by limited dynamic range of the display and/or recording medium are overcome by parallel recordings of data at different gain levels and automatic gain control. G.G.

N71-16155* Purdue Univ., Lafayette, Ind. Lab. for Agricultural Remote Sensing.

PHYSICAL MEASUREMENTS PROGRAMS AT LARS-PURDUE

Roger A. Holmes *in* NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 2 1968 24 p refs

Avail: NTIS CSCL08F

The Laboratory for Agricultural Remote Sensing (LARS) physical measurements group has the general responsibility for the conception, experimental design, calibration, and operation of instruments for the measurement of physical observables of the natural environment. The scope of the measurements program includes laboratory, field, aircraft, and satellite experiments seeking to define, measure, and utilize electromagnetic radiation phenomena in timely quantitative identity of agricultural and vegetative conditions.

Author

N71-16163* Michigan Univ., Ann Arbor.

RESULTS OF EARTH RESOURCE INVESTIGATIONS

Marvin R. Holter *in* NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 2 1968 21 p

Avail: NTIS CSCL08F

Research at the University of Michigan under the Earth Resources Program is focused on the problems of data processing/interpretation/utilization for agricultural purposes. Imagery and discrimination results for data obtained at an agricultural test site are presented and discussed. Aerial photography and scanner data, and ground data and measurements are presented. Results demonstrate great progress in discrimination over current operational aerial survey techniques.

A.L.

N71-16164* Kansas Univ., Lawrence. Center for Research in Engineering Science.

RADAR PROGRESS IN THE NASA EARTH RESOURCES AIRCRAFT PROGRAM

R. K. Moore *in* NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 2 1968 51 p refs

Avail: NTIS CSCL17H

Progress made in the application of radar to the Earth Resources Aircraft Program is reviewed. The radar systems used on the NASA aircraft, radar scatterometer and imaging radar, are described and discussed.

A.L.

N71-16165* Michigan Univ., Ann Arbor.

INFRARED STUDIES

D. S. Lowe *in* NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 2 1968 17 p

Avail: NTIS CSCL14B

The capabilities and limitations of using infrared scanners for thermal mapping and multispectral sensing in the NASA Remote Sensing Aircraft Program are discussed. Some of the advantages of using the relatively complex scanner are: (1) Scanners can operate in any region of the optical spectrum. (2) The electrical signal can be readily transmitted, recorded, analyzed, or processed as needed or desired. (3) The detectors generally have a very large dynamic range, and the detection process is reversible. (4) The sensor is amenable to calibration and can yield quantitative data. (5) Collection of data simultaneously in many wavelength channels is possible. The airborne multispectral instrumentation used at Michigan is described and discussed.

A.L.

N71-16179* Miami Univ., Coral Gables, Fla.

COMPARISON OF MICROWAVE RADIOMETRY OF THE OCEAN DURING HURRICANE BEULAH (MISSION 57) WITH

SIMULATED OCEAN SURFACE MEASUREMENTS

G. F. Williams, Jr. *in* NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 3 1968 8 p refs

Avail: NTIS CSCL08C

In order to provide a general guide in the interpretation of airborne microwave radiometer data over the ocean, a limited set of measurements of a simulated ocean surface was conducted. The experiment was designed to measure the apparent or brightness temperature in the microwave region of an air-water interface under various conditions. The radiometers were installed in a NASA aircraft, which parked with a temporary test tank 8 feet in diameter erected below the radome housing the radiometers. As calibration points, measurements were made on the asphalt pavement and then on the sky reflected from aluminum sheets before the test tank was erected. The tank was filled with fresh water and the apparent temperature was recorded. The water surface was then disturbed by a water spray to simulate the impact of rain on the surface, and the temperature was recorded. Then, 1 ounce of detergent was added, and a high-pressure jet generated one-fourth to one-half inch of foam on the water surface, simulating the effects of foam and whitecaps, and the measurements were repeated. The raw temperatures require corrections based on antenna and radome losses and on pattern effects which are not yet accurately established for the radiometer system.

Author

N71-16181* Michigan Univ., Ann Arbor.

SURFACE EFFECTS AND SUBMERGED FEATURES

F. C. Polcyn *in* NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 3 1968 18 p ref

(Contract N67306-67-C-0243)

Avail: NTIS CSCL08J

The observables upon which remote sensors rely for location and measurement of submerged oceanographic features are color and thermal anomalies, wave refraction effects, and time differences of reflected laser pulses. These aspects for the identification and location of a particular depth of water (100 feet or less) are outlined. The various sensor types that could be employed to operate on these observables are suggested. The problems associated with the use of each observable were investigated and a series of experiments to verify their usefulness is recommended. One of the aspects of remote sensing that must be investigated is the conditions under which a reliable depth determination can be made from observed surface anomalies.

Author

N71-16185* Kansas Univ., Lawrence. Center for Research in Engineering Science.

RADAR PROGRESS IN THE NASA EARTH RESOURCES AIRCRAFT PROGRAM

R. K. Moore *in* NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 3 1968 51 p refs

Avail: NTIS CSCL08F

A historical survey is presented on the development of airborne radar scatterometers for application in earth resources surveys. The functions of the scatterometer and the imaging radar used in the Earth Resources Program are described.

R.B.

N71-16186* Michigan Univ., Ann Arbor.

INFRARED STUDIES

D. S. Lowe *in* NASA. Manned Spacecraft Center Earth Resources Aircraft Program Status Rev., Vol. 3 1968 17 p

Avail: NTIS CSCL14B

The NASA Remote Sensing Aircraft Program uses infrared scanners for thermal mapping and multispectral sensing. A few aspects of what can or cannot be done with the current scanner instrumentation are discussed.

Author

08 INSTRUMENTATION AND SENSORS

N71-16387# Sandia Corp., Albuquerque, N.Mex. Aerodynamics Div.

DEVELOPMENT OF SEA ICE PENETROMETER

C. W. Young and J. L. Kiker Aug. 1970 85 p refs
(SC-DR-70-483) Avail: NTIS

A series of drop tests was performed in fast winter ice to demonstrate the feasibility of remotely determining the thickness of sea ice by using instrumented, air-dropped penetrometers. Seven drop tests were made to study the effect of projectile weight (25 to 100 pounds), weight-to-area ratio (5.4 to 11.2 pounds per square inch), impact velocity (200 to 345 feet per second), and ice condition (sea ice and one test in a brackish lagoon). It appears that an optimum configuration for an ice penetrometer weighs 50 pounds, is 2.75 inches in diameter, and should impact the ice at 450 to 500 feet per second. The index of penetrability for the sea ice was 2.8, which corresponds in penetrability to an extremely hard soil or very soft rock. The ice thickness was determined to an accuracy of + or - 4 inches, but by using techniques developed during these tests, it is estimated the ice thickness can be determined to + or - 2 inches in future tests. Author (NSA)

N71-16548# Old Dominion Univ. Research Foundation, Norfolk, Va.

TRIAD: PRELIMINARY DESIGN OF AN OPERATIONAL EARTH RESOURCES SURVEY SYSTEM. 1969 SUMMER FACULTY FELLOWSHIP PROGRAM IN ENGINEERING SYSTEMS DESIGN

Keith R. Carver, F. D. Hart, C. E. Jarvis, J. D. Lowther, and F. L. Moreadith, eds. 22 Aug. 1969 148 p refs
(Contract NSR-47-003-010)

(NASA-CR-116200) Avail: NTIS CSCL 08D

The results of a multidisciplinary system design study directed towards the definition of a preliminary design concept for an operational earth resources survey program are presented. The study includes: (1) evaluation of social needs in relation to basic resources of food, raw materials, power and conservation, (2) technological, political, and social feasibility, and (3) description of an operational system. World problems of a socio-economic nature pertinent to the survival and progress of civilization are summarized. Also, the disciplines of agronomy, geology, geography, oceanography, hydrology, and others, are surveyed from a user-agency point of view. Specific data needs are presented that existing agencies have expressed a desire to acquire. Parameters to be measured, minimum resolution requirements, and likely sensors are indicated for each need. A total concept for an operational earth resource survey system is discussed. This includes types of data to be acquired, specifications of sensors and platforms, data processing and distribution, and illustration of an administrative structure for carrying out an operational program. Author

N71-16567# Woods Hole Oceanographic Institution, Mass.

EXPERIENCE WITH A DRIFTING IRLS BUOY

G. C. Ewing and Foster L. Striffler Oct. 1970 12 p ref
(Contract N00014-66-C-0241)

(AD-713948; WHOI-REF-70-53) Avail: NTIS CSCL 13/10

The report gives a description and results of an operational test of an IRLS (Interrogation, Recording and Location Subsystem) free-floating buoy conducted in Woods Hole Harbor and in the vicinity of Georges Bank in conjunction with NASAS NIMBUS II SATELLITE. Author (GRA)

N71-17201# Joint Publications Research Service, Washington, D.C.

A GYROOPTICAL VERTICAL

A. A. Babayev In its Gyroscopic and Navigational Instr. 20 Jan. 1971 p 11-18 refs
Avail: NTIS

In an instrument equipped with an optical-mechanical scanning unit along the cone's generatrix, it is suggested that the unit of

a gyro stabilizer be expanded and that the scanning unit be used as an astatic gyroscope for the construction of a vertical. The principle was tested on a simulator. The kinematic system and a diagram of the experimental model are shown. Author

N71-18402# Massachusetts Inst. of Tech., Cambridge. Measurement Systems Lab.

MULTI-SPECTRAL AND THERMAL SCANNER EXPERIMENTS ALONG THE MASSACHUSETTS COASTLINE Final Report

A. C. Conrod Apr. 1970 12 p

(Contract NAS12-2213)

(NASA-CR-116782; RN-64) Avail: NTIS CSCL 08J

Multispectral imagery was obtained for several coastal and other sites in eastern Massachusetts in the spring and summer of 1969. Color aerial photography and thermal infrared imagery were acquired for some of the sites simultaneously with the multispectral imagery. Results of the experiments are reported for a thermal mapper survey of Boston Harbor; photographic, multispectral and thermal images of Plum Island, Massachusetts, and multispectral coverage of a dye-tracing test outside of Boston Harbor. Author

N71-21054# AEG-Telefunken, Ulm (West Germany). Fachbereich Schiffbau, Flugwesen, Sondertechnik.

A FEASIBILITY STUDY OF A SCANNING IR-RADIOMETER FOR USE IN AN OPERATIONAL METEOROLOGICAL SATELLITE Final Report

W. Fibich and J. Helm [1970] 95 p refs

(Contract ESTEC-853-69-HP)

Avail: NTIS

The preferred design of the scanning radiometer scans the earth or cloud surfaces with two rotating mirrors. Each of them illuminates after focusing in a mirror objective of Cassegrainian type two independent visible and IR-detectors. Therefore a redundancy of the signals from the detectors and their amplifiers is given. The reliability is from this point of view higher than that given in the MTBF calculation. The proposed scanning radiometer needs for online transmission only one transmitter of the visible range and the IR-picture excellently adapted to the APT-system. The data of the IR-scans of one orbit can be stored by a tape recorder. In playback these stored data are given with high speed transmission to the ground station. Author (ESRO)

N71-21445# Michigan Univ., Ann Arbor. Willow Run Labs.

INVESTIGATION OF MULTISPECTRAL DISCRIMINATION TECHNIQUES

R. F. Nalepka Jan. 1970 199 p refs Original Contains Color Illustration

(Contract USDA-12-14-100-9548(20))

(Rept-2264-12-F) Avail: NTIS

The improvement multispectral discrimination techniques for remote sensing in agriculture is discussed. Investigations included the recognition processing of wheat and the study of certain preprocessing transformations to reduce the deleterious effects of changing illumination and source-target-sensor aspect angles. Comparison of photographic and multispectral data collected over Imperial Valley, California, is outlined. An analysis is summarized of data calibration, the effects of atmospheric scattering, and the use of predictive models. Author

N71-21785# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.

THE USE OF CO AND CO2 LASERS TO DETECT POLLUTANTS IN THE ATMOSPHERE

Robert T. Menzies Dec. 1970 32 p refs

(Grant AF-AFOSR-1492-68)

(AD-717171; AFOSR-70-2921TR) Avail: NTIS CSCL 14/2

Several spectral coincidences between CO laser emission lines and infrared absorption lines of oxides of nitrogen have

recently been observed. Using existing infrared spectroscopy data, we predict additional spectral coincidences: the Q-switched CO laser emits certain lines which overlap SO₂ absorption lines, and certain frequency doubled CO₂ laser lines overlap NO and CO absorption lines. Other spectral overlaps involving the CO₂ laser have been reported elsewhere. Based on such coincidences remote sensing of these atmospheric constituents can be accomplished by observing resonant absorption, thermal emission, or fluorescence. The authors discuss sensitivities for each of these methods, using data on line strengths and pressure broadened line widths. Wide band heterodyne receivers offer high sensitivity when they can be used; our discussion included the use of this type of receiver system. Author (GRA)

N71-21892# National Environmental Satellite Center, Washington, D.C.

POTENTIAL OF SATELLITE MICROWAVE SENSING FOR HYDROLOGY AND OCEANOGRAPHY MEASUREMENTS

John C. Alishouse, Donald R. Baker, E. Paul McClain, and Harold W. Yates Mar. 1971 22 p refs
(NOAA-TM-NESS-26) Avail: NTIS

Hydrologic or oceanographic use of visible or infrared radiation measurements from earth satellites is seriously limited by the opacity of clouds at these wavelengths. Microwave radiation at frequencies which are subject to relatively small attenuation by clouds and other atmospheric constituents offers a means to circumvent this limitation. Microwave sensors that can be carried on unmanned satellites should be able to provide measurements usable for the delineation of snow and ice cover and the detection of precipitation; also, there is considerable promise that soil moisture measurements that are quantitative to some degree can be made. Microwave radiometers on unmanned satellites appear usable for detecting sea-ice boundaries through clouds and for obtaining information of sea-surface roughness and temperatures. Author

N71-22533*# National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Research Labs.

DEVELOPMENT OF A SYSTEM FOR REMOTE SENSING OF IONOSPHERIC MOTIONS AND MICROSTRUCTURE: THE KINESONDE IN FRANCE, 1970

J. W. Wright, W. Plywaski, and L. S. Fedor Jan. 1971 111 p refs

(NASA Order W-13039; Grant NATO-413; NOAA Proj. 251405630)

(NASA-CR-117837; NOAA-ERLTM-OD-6) Avail: NTIS CSCL 04A

A program of investigations is reported with goals that include: (1) development of what is considered to be a suitably competent measurement system, the digitized multifrequency complex-amplitude Kinesonde; (2) refinement of a statistically-rigorous procedure for correlation analysis of spaced-sensor measurements; and (3) completion of several series of simulated and actual experiments. In particular, the experimental program was conducted to compare E-region Kinesonde measurements with time-dependent neutral wind profiles obtained by the meteor wind technique, and over a broader range of altitudes extending into the F region, to compare the Kinesonde results against Thomson scatter measurements of meridional ion drift. A few early comparisons with meteor winds suggest that the Kinesonde technique, applied within the daytime E-region, observed the neutral wind profile directly; the standard point source correction appears valid. Author

N71-25257*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

MULTISPECTRAL TERRAIN PHOTOGRAPHY FROM APOLLO 9

Paul Lowman In *its Significant Accomplishments in Sci. and Technol. at Goddard Space Flight Center* 1970 p 5-10 Original contains color illustrations

Avail: NTIS HC\$6.00/MF\$0.95 CSCL 14E

Four coaxially mounted cameras on Apollo 9 were used simultaneously in multispectral terrain photography for earth

resources purposes. The electrically driven equipment utilized different film-filter combinations and was mounted in the hatch window of the command module. Results show that: (1) black and white film with a red filter is best for topographical mapping because of its high resolution; (2) colored infrared film provides the best general purpose pictures; and (3) colored film depicts optimal regional geological structures. G.G.

N71-25980# Aerojet-General Corp., El Monte, Calif. Microwave Div.

MICROWAVE EMISSION CHARACTERISTICS OF NATURAL MATERIALS AND THE ENVIRONMENT: A SUMMARY OF SIX YEARS RESEARCH Final Technical Report, 8 Jan. 1965-15 Feb. 1971

A. T. Edgerton, F. Ruskey, D. Williams, A. Stogryn, and G. Poe Feb. 1971 304 p refs

(Contract N00014-70-C-0351)

(AD-720388; AGC-9016R-8) Avail: NTIS CSCL 8/13

The document is the eighth and final technical report of the series. It summarizes six years of basic and applied research into the microwave emission characteristics of natural materials and the environment. Research activities encompass investigations of the ocean and coastal environment, snowpack and ice studies, sediment and soil studies, dielectric constant measurements and techniques, and analytical modeling of natural materials and the environment. Field studies were conducted with a mobile microwave field laboratory containing a number of microwave radiometers and supporting instrumentation. Oceanographic research has been concerned with the effects of microwave emission of ocean surface roughness, water temperature, salinity, and surface pollutants. Hydrologic studies were concerned with the physics of microwave emission by snowpacks, fresh and sea ice. Other investigations have been concerned with the emission characteristics of sediments and soils and the determination of soil moisture content with microwave radiometry. The report also provides a detailed account of the current years research which entails multiwavelength microwave radiometric measurements and numerical modeling of controlled, small scale waves. Author (GRA)

N71-26646# Geological Survey, Washington, D.C.

GAS CHROMATOGRAPHIC DETERMINATION OF CARBONATE CARBON IN ROCKS AND MINERALS

John Marinenko and Irving May In *its Geol. Surv. Res.* 1970, Chapter D 1970 p D103 D105 refs

Avail: SOD \$3.75

A simple, rapid, and direct gas chromatographic method for determining carbonate carbon in rocks and minerals was developed. Powdered samples are heated with phosphoric acid, and evolved gases are separated on a silica-gel column. Carbon dioxide is detected by thermal conductivity using helium as a carrier gas. The method is most applicable for determining carbon dioxide when only a limited quantity of sample is available. As little as two micrograms of carbon dioxide can be determined. Author

N71-27484 World Meteorological Organization, Geneva (Switzerland).

RADIATION INCLUDING SATELLITE TECHNIQUES

1970 588 p refs Proc. of the WMO/IUGG Symp., Bergen, Aug. 1968

(WMO-248-TP-136; TN-104) Copyright. Avail: Issuing Activity
Conference papers on solar radiation, spectroscopy, instrumentation, and radiation climatology are presented.

ESRO

N71-27480 World Meteorological Organization, Geneva (Switzerland).

INSTRUMENTATION OF THE SATELLITE COSMOS-149 FOR MEASUREMENTS OF RADIATION CHARACTERISTICS OF THE EARTH

A. K. Gorodetsky, M. S. Malkevich, G. V. Rozenberg, V. I. Syachinov, and G. P. Farapovna In *its Radiation Including Satellite Tech.*

08 INSTRUMENTATION AND SENSORS

1970 p 25-36 refs

Copyright. Avail: Issuing Activity

The main characteristics of Cosmos 149 instruments used for measurement of solar and infrared radiation emerging from the earth are discussed. The photometers, IR radiometers, and instruments for radiation balance measurements are described. Results are shown in the form of curves. ESRO

N71-27500 World Meteorological Organization, Geneva (Switzerland).

DETERMINATION OF THE SURFACE AND CLOUD TEMPERATURE BY MEASUREMENTS OF THE EARTH'S RADIATION IN THE 8-12 MICRONS WINDOW BY THE SATELLITE COSMOS 149

A. K. Gorodetsky and M. S. Malkevich *In its Radiation Including Satellite Tech.* 1970 p 95-99 refs

Copyright. Avail: Issuing Activity

The IR-radiometer of Cosmos 149 which measured the thermal radiation of the earth in the from 8 to 12 microns range has been used for the determination of surface or cloud temperature. The reliability of the measurements and the assessment of temperatures are discussed. ESRO

N71-27551 Lille Univ. (France). Dept. of Physics.

DESIGN OF AN INFRARED RADIOMETER FOR MEASURING SEA-SURFACE TEMPERATURE

Pierre Yves Deschamps and Pierre Lecomte *In WMO Radiation Including Satellite Tech.* 1970 p 413-415 refs

Copyright. Avail: Issuing Activity

The design of an infrared radiometer suitable for ocean-surface temperature measurements with an accuracy of about 0.3 C is described. This instrument relies on comparison of the energy coming from the surface of the water and that of a temperature controlled black body cavity. ESRO

N71-27621# Aerojet-General Corp., El Monte, Calif. Space Div. **PASSIVE MICROWAVE MEASUREMENTS OF SNOW, SOILS, AND OCEANOGRAPHIC PHENOMENA Technical Report, 16 Nov. 1967 - 15 Nov. 1968**

A. J. Edgerton, D. T. Trexler, G. A. Poe, A. Strogryn, S. Sakamoto et al Feb. 1970 183 p refs
(Contract Nonr-4767(00))

(AD-714855; SD-9016-6; TR-6) Avail: NTIS CSCL 14/2

Research performed during the period of this report consisted of a combination of field and laboratory investigations of the microwave emission characteristics of natural materials, and analytical modeling of the microwave radiation characteristics of selected materials to establish a better understanding of the physics of microwave emission. Author (GRA)

N71-28126# Royal Aircraft Establishment, Farnborough (England).

EARTH RESOURCES SATELLITES

S. L. Entres Oct. 1969 88 p

(RAE-TR-69219) Copyright. Avail: NTIS

Operational and technical aspects of earth resources satellite projects are discussed. Two basic surveying methods are considered: by remote sensing satellites and by measurement-collecting satellites. Attention is concentrated on problems of orbital sensing of electromagnetic earth radiance in the visual, infrared and microwave regions. The principles of polychromatic measurement of earth surface radiation signatures and their analysis as well as some matters connected with the data handling of the sensed information are discussed. Recommendations are made for some useful fields of study and for complementary experimental work. A list of organizations engaged in relevant branches of science and technology together with classified bibliographic references are appended. Author

N71-28350# Air Force Cambridge Research Labs., Bedford, Mass. Ionospheric Physics Lab.

INVESTIGATION OF THE 60 GHz ATMOSPHERIC OXYGEN MANTLE FOR APPLICATION TO VERTICAL SENSING

Donald A. Guidice 26 Jan. 1971 63 p refs

(AD-722044; AFCRL-71-0116; ERP-348) Avail: NTIS CSCL 4/1

The feasibility of a microwave vertical sensor depends on the uniformity of the radiometric temperature of the earth's O2 mantle at some operating frequency in the 60-GHz(5-mm wavelength) range. The essential properties of passive vertical sensors are examined. The characteristics of the 5 mm O2-band emission from the earth's atmosphere are analyzed. The potential accuracy of a 60 GHz O2-band vertical sensor is determined, considering both instrumental and O2 mantle uniformity limitations. To take the data required to evaluate the O2 mantle uniformity, a downward-looking radiometric instrument operating at 60.80 GHz was designed and built by Ewen-Knight Corporation. The design of the instrument is analyzed from the atmospheric physics and the instrument engineering viewpoints. The instrument, designated Experiment CRLF 739, was accepted for flight aboard the OAR satellite OV1-86; the details of interfacing the instrument with OV1-86 are discussed. Author (GRA)

N71-28444# Planning Research Corp., Los Angeles, Calif.

A SYSTEMS ANALYSIS OF APPLICATIONS OF EARTH ORBITAL SPACE TECHNOLOGY TO SELECTED CASES IN WATER MANAGEMENT AND AGRICULTURE. VOLUME 1: TECHNICAL SUMMARY

Nov. 1969 64 p refs Revised

(Contract NASw-1816)

(NASA-CR-119010; PCR-R-1224-Vol-1-Rev) Avail: NTIS CSCL 02C

A concept for employing multispectral remote sensors onboard spacecraft as a part of an information system to assist in management of specific water resource and agricultural activities is proposed and evaluated. The specific applications studied were (1) water management of the Columbia River Basin to increase benefits from hydropower generation, irrigation, flood control, navigation, and recreation; (2) management of wheat crop yield and inventory control for the United States, considering worldwide wheat demand and production; and (3) early detection and control of wheat rust fungi to increase the wheat yield in the United States. The system concept includes four satellites, each carrying three remote sensors along with appropriate equipment for attitude control, data storage, and telemetry. A multispectral scanner, a multispectral television, and a multiband radar are used for remote sensing of earth phenomena. The ground components comprise five data receiving (and command and control) sites that forward data to a centralized location for processing and information analysis. The estimated total incremental cost of this conceptualized system was compared with the estimated potential benefits from each application. Benefits and cost of the space-assisted information system were compared to benefits and costs of an aircraft-assisted information as well as of selected non-information alternatives. Author

N71-28445# Planning Research Corp., Los Angeles, Calif.

A SYSTEMS ANALYSIS OF APPLICATIONS OF EARTH ORBITAL SPACE TECHNOLOGY TO SELECTED CASES IN WATER MANAGEMENT AND AGRICULTURE. VOLUME 2: TECHNICAL REPORT

Nov. 1969 323 p refs Revised

(Contract NASw-1816)

(NASA-CR-119011; PRC-R-1124-Vol-2-Rev) Avail: NTIS CSCL 02C

A systems analysis is presented of three of the many uses of space technology for earth applications including the management of the regional demand and supply of water (emphasizing the generation of hydroelectric power, flood control, irrigation, and recreation); the management of the world wheat crop (emphasizing the impact of fluctuations on the United States as the major exporter); and the control of wheat rust, a principal cause of wheat losses in the United States and abroad. The estimated total system costs, including R and D, investment, and 20 years' annual operating costs were evaluated. The United States' benefits from the

three cases were estimated at 10.5 billion for the 1970-90 period, and world benefits were estimated at \$50 billion. The wheat rust case requires more frequent monitoring (every 12 hours) by the four-satellite system proposed and the use of radar. Aircraft overflights offer a lower cost alternative than a satellite system used solely for wheat rust control. The water management case required 6-hour coverage and the full use of the satellite system. The cost-benefit ratios are substantial, and the satellite is superior to aircraft and other alternatives if a major portion of the United States' river basins are covered. Author

N71-28446* Planning Research Corp., Los Angeles, Calif.
A SYSTEMS ANALYSIS OF APPLICATIONS OF EARTH ORBITAL SPACE TECHNOLOGY TO SELECTED CASES IN WATER MANAGEMENT AND AGRICULTURE. VOLUME 2: TECHNICAL REPORT, APPENDICES
 Nov. 1969 558 p refs Revised
 (Contract NASw-1816)
 (NASA-CR-119012; PRC-R-1224-Vol-2-App-Rev) Avail: NTIS HC \$6.00/MF \$0.95 CSCL 02C

Appendices are presented for the systems analysis of satellite borne remote multispectral sensors for application to water and wheat crop management and wheat fungi control. Hydrology and agriculture user sensor models and hydrological models are included as well as system operation and benefits, data, satellite system description and costs, alternative information systems, noninformation alternatives, wheat production management, and wheat rust control. J.M.

N71-28731# TRW Systems Group, Redondo Beach, Calif.
THE DEVELOPMENT OF A WISP INFORMATION SYSTEM
Final Report
 Keith P. Jenkin and Richard C. Ramsey 25 Feb. 1971 149 p
 (Contract N62306-70-C-0274)
 (AD-721385) Avail: NTIS CSCL 9/2

A data handling system was developed for WISP data. The procedure for the reduction of the raw flight data to graphic displays were refined in the program. Computed-generated maps are presented which enhance the various scene features and these are based upon the selection of the appropriate algorithms to fit the scene information. Polarization measurements of the airlight directed upward over the oceans were obtained up to 10,000 feet altitudes. The high values of polarization obtained suggest a significant gain in signal contrast will result from use of polarizers in spacecraft ocean color sensors. Low altitude spectrometer flights over sewage outfalls and red tide resulted in good correlation between the visible spectral nature of the upwelling light and ground truth turbidity and organism counts. Useful algorithms were developed to best characterize the nature of the spectral data and the existing types of water pollution. Spectrometer measurements of a deliberate oil spillage on the ocean indicated no visible signatures were present. Author (GRA)

N71-29217# Montana State Univ., Bozeman.
AN AIRBORNE RADIOMETRIC SNOW SURVEY SYSTEM
 Paul W. Jordan Sep. 1970 87 p
 (Contract AT(45-1)-2061)
 (RLO-2061-1) Avail: NTIS

A prototype system for the airborne measurement of the water equivalent stored in a snowpack on an inaccessible mountain watershed is described. The ground emplacement consists solely of a radiosotope; the reduction in upward gamma flux is related to snow-water content lying above that source. The airborne system and technique necessary to measure and accomplish this are outlined. The mathematical relationships involved are evaluated; and the method of determining each of the parameters of altitude, airspeed, gamma count, etc. is discussed. Experimental validation is cited. As an adjunct to developing a prototype system for

measuring, from the air, snow-water equivalent, it was necessary to design tables and graphs to relate maximum expected snow-water depth to isotope type and magnitude and to shield thickness and weight. Data are developed and presented in graph form, which will allow a quick decision as to the optimum combination of elements for any new snow course site which may be under consideration. Author (NSA)

N71-29910* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
EARTH PHOTOGRAPHY FROM HIGH-ALTITUDE BALLOONS
 Dona L. Cauchon, Leonard P. Kopia, and Leon A. Williams, Jr.
 Washington Jul. 1971 35 p refs
 (NASA-TM-X-2208; L-7436) Avail: NTIS CSCL 14E

Large-area photographs of the earth were obtained from high-altitude balloon platforms. Some of the photography was coordinated with ground investigations for experimental purposes. The usefulness of large-area photographs and unique photographic formats is evaluated. Certain advantages and disadvantages of free-flight balloons as remote sensing platforms are discussed. Two appendices detail the camera system and camera-package design. Author

N71-30176# Grumman Aerospace Corp., Bethpage, N.Y.
 Geo-Astrophysics Section.
AUTOMATED DELINEATION OF WETLANDS IN PHOTOGRAPHIC REMOTE SENSING
 Walter G. Egan and Malcolm E. Hair (Adelphi Univ.) Jun. 1971 24 p refs Presented at the 7th Intern. Symp. on Remote Sensing of Environment, Ann Arbor, Mich., 17-21 May 1971 (RM-509J) Avail: NTIS

Precision automated photometric mapping of wetlands in Calvert County, Maryland, has been achieved in an operational system as the result of a program including aerial color film (both true color and false color infrared) calibration and control. Although the system was operated over this area, it may be adapted to other areas. The recognition appears to be most accurately achieved by microdensitometer analysis of the true color transparency in a narrow band centered in the red (0.633 micrometer, on 3000-foot altitude imagery. A computer-generated map is presented. Author

N71-31383# National Oceanic and Atmospheric Administration, Rockville, Md. BOMAP Office.
HIGH LEVEL CLOUD PHOTOGRAPHY INVENTORY, BOMEX PERIOD 2, 24 MAY - 10 JUN. 1969
 Vance A. Myers Mar. 1971 88 p
 (NOAA-TM-ERL-BOMAP-4) Avail: NTIS

The high-level photography missions flown by U.S. Air Force RB-57F aircraft during the Barbados Oceanographic and Meteorological Experiment (BOMEX) Period II, May 24-June 10 are identified. Tables and flight tracks give the time and location of each of the 1500 photographs taken. Author

N71-32997# Deutscher Wetterdienst, Offenbach am Main (West Germany).
CONTRIBUTIONS TO THE METHODOLOGY OF WATER SURFACE TEMPERATURE MEASUREMENTS USING INFRARED RADIATION THERMOMETERS [ZUR METHODIK DER OBERFLAECHENTHEMPERATURMESSUNG VON WASSER MIT INFRAROT-STRAHLUNGSTHERMOMETERN]
 Dieter Lorenz Bonn Bundeswehramt 1971 68 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. fuer Verteidigung

(BMVg-FBWT-71-6) Avail: NTIS; Bundeswehramt, Bonn: 25 DM
 Results of theoretical and experimental radiometric measurements of water surface temperatures are presented. A description is given of the experimental set-up and the necessary

08 INSTRUMENTATION AND SENSORS

corrections. Comparison of these and bucket thermometer measurements show agreement and confirm the usefulness of this method. ESRO

N71-34328# Joint Publications Research Service, Washington, D.C.

RESULTS OF A COMBINED FULLY-INSTRUMENTED SUBSATELLITE GEOPHYSICAL EXPERIMENT

K. Ya. Kondratyev et al. 24 Aug. 1971 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR. (Moscow), v. 196, no. 6, 1971 p 1333-1336

(JPRS-53895) Avail: NTIS

Photography and spectrophotometry of the earth's surface along the route Caspian Sea-Ust'-Urt-Aral Sea were provided for the purposes of solving the indicated missions in the program of scientific experiments on the SS Soyuz-6 and Soyuz-7. In order to obtain information on the transmittance function of the atmosphere on the specified route, flights were carried out in IL-2 and IL-18 aircraft with a full set of apparatus, in which devices analogous to those which were installed on the SS were a part. At the same time, a physical-geophysical inventory of the surface along the flight path was conducted by ground crews. A combined experiment with the simultaneous effort of a ground crew, aircraft, and SS was carried out. Some results are reported. Author

N71-34441*# Illinois Univ., Urbana. Antenna Lab. THE EFFECT OF COHERENCE AND MULTIPLE SCATTERING ON LASER RADAR AIR POLLUTION MEASUREMENTS

H. C. Sievering and R. Mittra Jun. 1971 175 p refs (Grant NGR-14-005-009)

(NASA-CR-121873; Rept-71-5; SR-18; UIIU-ENG-71-2544) Avail: NTIS CSCL 02E

A review of the remote sensing field with applications to air quality monitoring was conducted. It is concluded that laser radar is the most promising remote sensing device for the broadest range of air pollution measurements. A radar equation taking account of dependent scattering as related to laser coherence properties is determined. The effect of multiple scattering on laser radar pulse distortion is calculated by a Monte Carlo technique for all orders of multiple scattering. Multiple scattering effects cause many more photons to be entirely lost from the beam long before pulse distortion occurs. However, the most important conclusion of this work is that dependent scattering may be observed with appropriate laser radar system parameters and that operation in a coherent and an incoherent mode of operation can allow for discrimination of the backscatter signal by pollutant particulates and molecular constituents. Author

N71-35280*# Montana Univ., Missoula. Cooperative Wildlife Research Unit.

DEVELOPMENT OF SATELLITE-RELATED BIOTELEMETRY EQUIPMENT Progress Report

J. J. Craighead, F. C. Craighead, Jr., and Joel R. Varney 31 Jul. 1971 111 p refs

(Grant NGR-27-002-006)

(NASA-CR-121893) Avail: NTIS CSCL 06B

The radiolocation system developed for use on elk and grizzly bear was used in the Interrogation Recording Location System (IRLS) elk tracking experiment conducted during the spring and summer of 1970. Experience was gained in integrating this equipment with the IRLS collar and in using it to locate the elk both on the ground and from the air to check satellite location data. Techniques were tested for interrogating the IRLS collar from an aircraft which may prove useful as a supplement to satellite interrogations or in helping to locate an animal with a malfunctioning collar. An improved directional antenna and location technique were developed which facilitate location of instrumented animals by aircraft. Physiological instrumentation work was directed toward experiments with black bears in their winter dens. This approach allows efforts to be concentrated on equipment and instrumentation techniques

without requiring the expenditure of a large number of man-hours locating and following instrumented animals. At the same time it is providing information on the life history of wild bears. Author

N71-35332# Research Inst. of National Defence, Stockholm (Sweden).

SIXTH SYMPOSIUM ON REMOTE SENSING [SJAETTE SYMPOSIET OM REMOTE SENSING I ANN ARBOR DEN 13-16 OKTOBER 1969]

Erik Fagerlund, Mats Forsell, and Harald Svensson Jan. 1970 35 p In SWEDISH Conf. held at Ann Arbor, Mich., 13-16 Oct. 1969

(FOA-2-C-2365-52) Avail: NTIS

The proceedings of a symposium on remote sensors are presented. The use of remote sensing techniques in the field of scientific geological applications is discussed. Different techniques, apparatus, and systems for collecting and processing data are described. Author

N71-35494# Naval Intelligence Command, Alexandria, Va. Translation Div.

THE PROBLEM OF INCREASING THE ACCURACY OF MEASUREMENT OF THE SURFACE TEMPERATURE OF SEAS AND OCEANS BY MEANS OF AN AIRBORNE INFRARED RADIOMETER [K VOPROSU OB UVELICHENII TOCHNOSTI IZMERENIYA TEMPERATURA POVERKHOSTI MOREY I OKEANOV S POMOSHCHYU INFRAKRASNOY RADIOMETRICESKOY APPARATURY SSAMOLET-A]

N. Verenchikov 16 Jul. 1971 13 p refs Transl. into ENGLISH from TR. Gl. Geofiz. Observ. (Leningrad), no. 235, 1970 p 146-154

(AD-726512; NIC-Trans-3228) Avail: NTIS CSCL 08/10

The use of infrared radiometric apparatus to measure the surface water temperature of seas and oceans is seeing increased use at the present time in the Soviet Union and abroad. Its installation aboard aircraft allows data to be collected from large areas in a short period of time. It is extremely important that the measurement errors be as small as possible. The errors in measurement may be divided into static and dynamic varieties. Static errors include those involving errors in the apparatus itself and those which are caused by the effect of the atmosphere on the measurement results; dynamic errors are encountered in connection with averaging the water surface temperature due to the finite dimensions of the field of vision of the apparatus and its inertia. Author (GRA)

N71-35495# Air Force Cambridge Research Labs., Bedford, Mass.

GRADIOMETER APPLICATIONS AND STATUS OF SENSOR DEVELOPMENT

David Anthony 1 Jun. 1971 25 p refs

(AD-727033; AFCRL-71-0314; ERP-355) Avail: NTIS CSCL 14/2

A number of feasible terrestrial and space applications exist for a sensor capable of measuring gravity gradients from a stationary or moving base. These applications include: aerial, marine, and satellite gravimetry; navigation and guidance; mass detection for location of tunnels and for inspection and evaluation of containers, satellites, and on-site missiles; lunar and planetary potential measurements, and asteroid mass measurements. Several different gradiometer designs can be used for these applications and are briefly reviewed. Author (GRA)

N71-35522# Sperry Rand Corp., Clearwater, Fla. Microwave Electronics Div.

RADIOMETRIC THERMACONDE PROGRAM Final Report, 15 May 1969 - 15 Feb. 1971

T. J. Lemmons 15 Feb. 1971 74 p

(Contract CPA-22-69-93)

(PB-199427; SJ-232-6062-15; APTD-0674) Avail: NTIS CSCL 14B

The final report is presented on the development of a microwave radiometer for measuring emission brightness temperature of oxygen molecules in the 50 to 75 GHz range. Included in the report are equipment specifications, requirements, and block diagrams. The instrument is intended to improve the pollution predicting capability of air pollution control personnel. J.G.M.

N71-36748# Kansas Univ., Lawrence. Center for Research, Inc.
PROJECT THEMIS: A CENTER FOR REMOTE SENSING
 Semiannual Technical Report, Sep. 1970 - Mar. 1971
 F. T. Ulaby Mar. 1971 190 p refs
 (Contract DAAK02-68-C-0089; Proj. Themis)
 (AD-726966; CRES-TR-133-23; ETL-CR-71-7; strp-7) Avail:
 NTIS CSCL 17/9

The report summarizes the technical progress under the subject contract on a broad interdisciplinary effort for the improvement of user utility of remotely sensed data. This effort involves theoretical work, sensor development, processing and display, and data analysis for specific user application. A number of technical reports and memoranda describing work underway are attached. Author (GRA)

N71-36748# Air Force Cambridge Research Labs., Bedford, Mass.
A REMOTE-SENSING INVESTIGATION OF FOUR MOJAVE PLAYAS. ENVIRONMENTAL RESEARCH PAPERS
 Carlton E. Molineux, Emmanuel E. Blampitis, and James T. Neal
 16 Apr. 1971 73 p refs
 (AD-727031; AFCRL-71-0235; AFCRL-ERP-352) Avail: NTIS CSCL 08/6

Dry lakebeds (playas) in the Mojave Desert are often hard and flat enough to serve as natural landing areas for aircraft. However, the surface physical properties of moisture, strength, and microrelief can vary with seasonal or local conditions. It is desirable to develop methods for determining and monitoring these properties and their variations. Airborne remote sensing enables collection of data on the reflectance, temperature, and emissivity of these surfaces that can be correlated with soil parameters. Four playas in the Mojave Desert that have a variety of surface properties were investigated. Airborne spectrophotography and thermal infrared imagery were obtained by overflights. Ground photometry and measurements of surface properties were obtained. Moisture-sensitive dyes were applied to one lakebed surface to evaluate the feasibility of monitoring its dryness through color changes apparent on the aerial photography. The report describes the results of the remote-sensing investigations and the correlation of photographic and imagery interpretation with actual surface conditions.

Author (GRA)

N71-36761 California Univ., San Diego.
A LASER EARTH STRAIN METER
 Jonathan Berger (Ph/D. Thesis) 1970 147 p
 Avail: Univ. Microfilms Order No. 70-16010

A laser interferometer for the study of earth strain is described. Changes in the length of an 800 m arm are measured by counting fringes in the interference pattern with a least count strain of 4×10 to the minus 10th power. The output is linear and has a flat response from dc to 1 MHz and a dynamic range of 1 million. The laser wavelength is controlled by reference to a passive optic resonator contained in a stable environment. The wavelength stability is a few parts in 10 to the 10th power for periods up to a laser lifetime (approximately 3000 hr). Drift and/or secular strain rates of 10 to the minus 10th power to 10 to the minus 8th power/day were observed over a period of a year. Earth tide observations are discussed with reference to the known ocean load perturbations. Observations of seismic events and microseisms are reported. Dissert. Abstr.

N71-37945# Allied Research Associates, Inc., Concord, Mass.
USE OF GROUND-TRUTH MEASUREMENTS TO MONITOR ERTS SENSOR CALIBRATION. VOLUME 2

Romeo R. Sabatini and George Rabchevsky Oct. 1970 108 p refs 3 Vol.
 (Contract NAS5-10343)
 (NASA-CR-121979; ARA-9G45-70-Vol-2; TR-16-Vol-2) Avail:
 NTIS CSCL 14B

The calibration of Earth Resources Technology Satellites (ERTS) sensors is described. Two alternative procedures for monitoring ERTS sensor calibrations at the ERTS Data Center are presented. The concept of ground-truth sites is central to the calibration procedures and ground-truth site requirements are discussed and site selections are specified. Prelaunch and postlaunch data requirements over these sites are described.

Author

N72-10275# Texas A&M Univ., College Station. Remote Sensing Center.
LABORATORY MEASUREMENT OF THE COMPLEX DIELECTRIC CONSTANT OF SOILS
 M. L. Wiebe Oct. 1971 35 p refs
 (Contract NAS9-11155; Grant NGL-44-001-001)
 (NASA-CR-123294; RSC-23) Avail: NTIS CSCL 08M

The dielectric constant of a material is an extremely important parameter when considering passive radiometric remote sensing applications. This is because the emitted energy measured by a microwave radiometer is dependent on the dielectric constant of the surface being scanned. Two techniques of measuring dielectric constants are described. The first method involves a dielectric located in air. The second method uses basically the same theoretical approach, but the dielectric under consideration is located inside a section of waveguide. Author

N72-10367 Stanford Univ., Calif.
REMOTE SENSING OF THE ATMOSPHERE BY OCCULTATION SATELLITES Ph.D. Thesis
 Jose Carlos Pomalaza-Diaz 1970 112 p
 Avail: Univ. Microfilms Order No. 70-18457

Information about the pressure and temperature profiles of the lower atmosphere is contained in the phase retardation suffered by electromagnetic waves propagating between coorbiting satellites separated by approximately 8000 km. For microwaves, the droplets of clouds produce negligible effects but, in the region below the 360 mB level, the atmospheric water vapor contribution to the total phase retardation is important. When the water vapor contribution is subtracted, six satellites, with separations selected so that microwaves propagate at five different levels, are sufficient to define the atmosphere in the region below 18 km. A least mean square iterative procedure can be used to infer the pressure and temperature parameters from the phase retardation data. It is concluded that, with six satellites and with accuracies of about 0.3 m and 0.5 dB for the phase and attenuation measurements, it is possible to define the pressure and temperature profiles with less than 3 mB and about 2 deg K accuracies, respectively, in the atmospheric region between the 70 and 780 mB levels. Dissert. Abstr.

N72-10396# Intermountain Forest and Range Experiment Station, Missoula, Mont. Northern Forest Fire Lab.
AIRBORNE INFRARED FOREST FIRE DETECTION SYSTEM
 Final Report, Apr. 1962 - Dec. 1967
 Ralph A. Wilson, Stanley N. Hirsch, Forrest H. Madden, and John B. Losensky May 1971 114 p refs
 (Contract OCD-OS-72-174; ARPA Order 636)
 (AD-726953; FSRP-INT-93) Avail: NTIS CSCL 02/6

The report outlines the basic requirements for an airborne infrared forest fire detection system and discusses the capability of the system to detect hot fire targets in natural forest backgrounds. Author (GRA)

N72-10878# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EXPERIMENT 8008: SYNOPTIC TERRAIN PHOTOGRAPHY
 Paul D. Lowman, Jr. and Herbert A. Tiedemann In its The Gemini Program: Phys. Sci. Expt. Sum. Sep. 1971 p 337-381 refs
 Avail: NTIS HC \$6.00/MF \$0.95 CSCL 14E

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N72-10884*# Air Force Systems Command, Wright-Patterson AFB, Ohio.
EXPERIMENTS D001, D002, AND D008: BASIC OBJECT, NEARBY OBJECT, AND SURFACE PHOTOGRAPHY
 Harold E. Geltmacher *In* NASA. Manned Spacecraft Center The Gemini Program: Phys. Sci. Expt. Sum. Sep. 1971 p 455-468
 Avail: NTIS HC \$6.00/MF \$0.95 CSCL 14E

N72-12272*# Agricultural Research Service, Weslaco, Tex. Soil and Water Conservation Research Div.
SPECTRAL REFLECTANCE FROM PLANT CANOPIES AND OPTIMUM SPECTRAL CHANNELS IN THE NEAR INFRARED
 William A. Allen, Harold W. Gausman, and Craig L. Wiegand *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 12 p refs

Avail: NTIS HC \$9.00/MF \$0.95 CSCL 08C

Theoretical and experimental aspects of the interaction of light with a typical plant canopy are considered. Both theoretical and experimental results are used to establish optimum electromagnetic wavelength channels for remote sensing in agriculture. The spectral range considered includes half of the visible and much of the near-infrared regions. Author

N72-12286*# Michigan Univ., Ann Arbor. Willow Run Labs.
SUMMARY OF MICHIGAN MULTISPECTRAL INVESTIGATIONS PROGRAM
 Richard R. Legault *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 31 p refs
 Avail: NTIS HC \$9.00/MF \$0.95 CSCL 14B

The development of techniques to extend spectral signatures in space and time is reported. Signatures that were valid for 30 miles have been extended for 129 miles using transformation and sun sensor data so that a complicated multispectral recognition problem that required 219 learning sets can now be done with 13 learning sets. Author

N72-12290*# Kansas Univ./Center for Research, Inc., Lawrence.
REMOTE SENSING AT THE UNIVERSITY OF KANSAS IN RADAR SYSTEMS
 Richard K. Moore *In* NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., Vol. 2 1970 39 p refs
 Avail: NTIS HC \$9.00/MF \$0.95 CSCL 17I

Demonstration that a spectral response across an octave bandwidth in the microwave region is as variable as the comparable response in the visible and infrared region is a major milestone and indicates the potential of polypanchromatic radar systems is analogous with that of color photography. Averaging of the returns from a target element appears necessary to obtain a grey scale adequate for many earth-science applications of radar systems. This result can be obtained either by azimuth averaging or by the use of panchromatic techniques (range averaging). Improvement with panchromatic techniques has been demonstrated both with a landbased electromagnetic system and with an ultrasonic simulator. The advantage of the averaging achieved in azimuth with the real-aperture version of the DPD-2 when compared with the synthetic aperture version confirms the concept. Author

N72-12394*# Philco-Ford Corp., Palo Alto, Calif. Western Development Labs. Div.
SCIENTIFIC STUDY UTILIZING PHILCO-FORD ELECTRONIC ENHANCEMENT VIEWER Final report, Oct. 1969 - Jun. 1971
 30 Jun. 1971 134 p refs Sponsored by NASA Original contains color illustrations (Contract N62306-70-C-0200) (NASA-CR-123481; AD-726757; WDL-TR-4498) Avail: NTIS CSCL 14E

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2. VIDEO ENHANCEMENT: PRINCIPLES AND TECHNIQUES. VIDEO COLOR ENHANCEMENT VIEWER 9 p See 14
3. ADDITIVE COLOR IMAGE ENHANCEMENT TECHNIQUES AND EQUIPMENT J. D. Lent (Calif. Univ., Berkeley) 12 p See 14
4. A COMPARISON OF ENHANCEMENT VIEWERS J. E. Estes (Calif. Univ., Santa Barbara) 27 p See 14
5. APOLLO 9 SCIENTIFIC EXPERIMENT NO. 065 R. N. Colwell (Calif. Univ., Berkeley) 33 p refs See 14
6. USE OF ENHANCEMENT EQUIPMENT ON AERIAL PHOTOGRAPHY OF GARDEN AND BUSH KEYS IN THE DRY TORTUGAS, FLORIDA H. J. Teas (Miami Univ., Coral Gables, Fla.) 11 p See 14
7. GEOLOGICAL STUDIES OF YELLOWSTONE NATIONAL PARK IMAGERY USING AN ELECTRONIC IMAGE ENHANCEMENT SYSTEM H. W. Smedes (Geol. Surv., Washington, D. C.) 18 p See 13
8. OPEN-PIT MINING EVALUATION: IMAGE ENHANCEMENT (TWIN BUTTES OPEN-PIT COPPER MINE), TUCSON, ARIZONA W. C. Henkes (Bureau of Mines, Washington, D. C.) 7 p See 13
9. OBSERVATION OF FINER DETAIL IN COLD SPRING FLOW PATTERNS ACROSS MONO LAKE (CALIFORNIA) USING AN INFRARED IMAGE J. P. Lyon and K. Lee (Stanford Univ., Calif.) 4 p See 08
10. AERIAL PHOTOGRAPHIC STUDIES OF THE COASTAL WATERS OF NEW YORK AND LONG ISLAND M. G. Kelly (Va. Univ., Charlottesville) 7 p See 14
11. SUMMARY AND CONCLUSIONS 2 p
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N72-12399*# Miami Univ., Coral Gables, Fla.
USE OF ENHANCEMENT EQUIPMENT ON AERIAL PHOTOGRAPHY OF GARDEN AND BUSH KEYS IN THE DRY TORTUGAS, FLORIDA
 Howard J. Teas *In* Philco-Ford Corp. Sci. Study Utilizing Philco-Ford Electron. Enhancement Viewer 30 Jun. 1971 11 p
 Avail: NTIS CSCL 14E

The feasibility of using image enhancement equipment to analyze vegetation is discussed. The area covered is Garden and Bush Keys in the Dry Tortugas island group. Photographs of the vegetation taken during aerial reconnaissance are provided. It is concluded that image enhancement equipment provides adequate identification of foliage and vegetation in the Florida Keys area. Author

N72-12400*# Geological Survey, Washington, D.C.
GEOLOGICAL STUDIES OF YELLOWSTONE NATIONAL PARK IMAGERY USING AN ELECTRONIC IMAGE ENHANCEMENT SYSTEM
 Harry W. Smedes *In* Philco-Ford Corp. Sci. Study Utilizing Philco-Ford Electron. Enhancement Viewer 30 Jun. 1971 18 p
 Avail: NTIS CSCL 14E

N72-13319# European Space Research Organization, Paris (France).
THE PHYSICAL AND TECHNOLOGICAL BACKGROUND OF REMOTE SENSING
 J. Plavín Aug. 1971 43 p refs Presented at the Tech. Consultation on the Appl. of Remote Sensing to the Management of Food and Agr. Resources, Rome, Sep. 1971
 Avail: NTIS

An introductory review, the main topics discussed are the basic physics of remote sensing, restricted to sources and interactions of electromagnetic energy between the ultraviolet and microwave regions of the electromagnetic spectrum. Information is given on (1) the influence of the intervening atmosphere between the object under study and the remote detector, (2) the technological background to remote sensing.

mentioning sensor types, remote sensing systems and methods, and (3) the different types of platforms used to mount remote sensing instruments, with particular attention to aircraft and satellite sensor platforms. ESRO

N72-13364# Joint Publications Research Service, Washington, D.C.

AIRBORNE AND SATELLITE IR SOUNDING

10 Dec. 1971 19 p refs Transl. into ENGLISH from Opt.-Mekh. Prom. (Leningrad), no. 3, 1971 p 3-9 and Lesn. Khoz. (Moscow), no. 5, 1971 p 60-64

(JPRS-54671; UDC-621.384.326.22:528.7) Avail: NTIS

Results of experimental studies conducted in 1967 demonstrated the high potentiality involved in utilizing infrared scanning equipment for various natural-scientific reasons. The data presented indicate the necessity of the most rapid adoption of infrared aerial photography in the national economy. Author

N72-14378*# Translation Consultants, Ltd., Arlington, Va. .
**SOME RESULTS OF THE INTEGRATED COMPOSITE
SUBSATELLITE GEOPHYSICAL EXPERIMENT**

K. Ya. Kondratyev, A. A. Buznikov, O. B. Vasilyev, B. V. Vinogradov, A. A. Grigoryev, Yu. Rabinovich, I., and L. I. Chapurskiy Washington NASA Nov. 1971 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, (Moscow), v. 196, no. 6, 1971 p 1333-1336

(Contract NASw-2038)

(NASA-TT-F-13894) Avail: NTIS CSCL 08G

A brief overview is presented for results obtained from the joint mission of Soyuz 6 and 7 and LI-2 and IL-18 aircraft. Aerial photographs were taken and spectrophotometric measurements made of the earth's surface along the Caspian Sea - Ustyurt-Aral Sea line. K.P.D.

N72-14395# Aeronautical Chart and Information Center, St. Louis, Mo. Technical Library Section.

**CHOICE OF THE OPTIMUM NUMBER OF GRAVIMETERS
FOR SIMULTANEOUS OBSERVATIONS**

G. T. Sobakar Jul. 1971 9 p refs Transl. into ENGLISH from Geofiz. Sb., Akad. Nauk Ukr. SSR, Inst. Geofiz. (Ukraine SSR), no. 34, 1970 p 48-50

(AD-729556; ACIC-TC-1748) Avail: NTIS CSCL 08/14

On the basis of the reliability coefficients of gravimeters and theorems of the probability theory, the solution of the problem of a set of gravimeters for simultaneous observations is given. It is shown that the optimum number of gravimeters with high reliability coefficients is equal to three. An increase in the number of gravimeters results only in complication and rise in the cost of a gravimetric survey. Author (GRA)

N72-14424# McMaster Univ., Hamilton (Ontario). Centre for Applied Research and Engineering Design.

**EARTH RESOURCE SATELLITES AND REMOTE AIRBORNE
SENSING Final Report**

J. MacDowall and B. H. Nodwell 31 May 1971 180 p refs (CARED Proj. 156)

Avail: NTIS

A survey of earth resource sensors which were available or under development was conducted to compile a comprehensive compendium of all the significant physical characteristics of remote sensors, together with some sketches illustrating their method of operation. For example, in the case of spectrometers, a table is included giving a numerical measure of twenty-three physical attributes, including size, weight and cost. This information is helpful in selecting the most appropriate available system for use, and will also help guide sensor development into those areas not covered by existing systems. The tables are arranged in such a way that comparison of characteristics between sensors is easily made. A brief introduction to each class of sensors is given, together with a brief description of each system. The discussions give an introduction to the physical

basis of each sensor and facilitate comparisons with other systems. For each of the major types of systems, a detailed questionnaire was drawn up and then sent to sensor manufacturers and developers. Author

N72-16085# Advisory Group for Aerospace Research and Development, Paris (France).

PROPAGATION LIMITATIONS IN REMOTE SENSING

John B. Lomax, ed. (Stanford Res. Inst., Menlo Park, Calif.) Oct. 1971 424 p refs Presented at the 17th Symp. of the Electromagnetic Wave Propagation Panel of AGARD, Colorado Springs, Colo., 21-25 Jun. 1971 Original Contains Color Illustrations

(AGARD-CP-90-71) Avail: NTIS HC \$6.00/MF \$0.95

Theoretical and experimental performance analyses are reported for various remote sensing systems in order to develop their propagation ranges and suitabilities in relation to investigated media. Results cover the spectrum from optical to radio frequencies.

N72-16086# Army Engineer Topographic Labs., Fort Belvoir, Va.

**A PROGRAM FOR THE DEVELOPMENT OF ADVANCED
CAPABILITIES FOR COLLECTION, ANALYSIS, PRODUCTION
AND DISSEMINATION OF MILITARY GEOGRAPHIC
INTELLIGENCE**

Kenneth R. Kothe In AGARD Propagation Limitations in Remote Sensing Oct. 1971 36 p

Avail: NTIS HC \$6.00/MF \$0.95

The objectives of the R&D program are identified as collection systems, data reduction systems and information systems. To improve data collection capabilities, work is described associated with sidelooking airborne radar and color multiband photographic systems. To improve the data reduction, research and development leading to automated image data extraction capability is reviewed. Then the development of a military geographic information system with an example output is outlined in relation to an overall concept. In conclusion, it appears the research and development objectives can be attained to implement the concept of operations in the 1985 time frame.

Author

N72-16087# Army Engineer Topographic Labs., Fort Belvoir, Va.

**PROJECT SAND: REMOTE SENSING FOR ENGINEER
CONSTRUCTION MATERIALS**

Donald G. Orr and James R. Quick In AGARD Propagation Limitations in Remote Sensing Oct. 1971 17 p refs

Avail: NTIS HC \$6.00/MF \$0.95

Remote sensor flights have been conducted over areas in the Mississippi Delta to determine the sensor configuration, analysis techniques, and diagnostic criteria for locating engineer construction materials under Project Sand. The sensor utilized included photography, thermal infrared, and sidelooking radar. In addition to the aerial imagery acquisition, ground measurements were made in each of the areas under investigation. The sensor imagery and ground truth data were analyzed by a team of experts in various earth science disciplines. The airborne operations and field data collection are described and a summary of the analyses results with unclassified illustrations are presented.

Author

N72-16090# Kansas Univ., Lawrence. Remote Sensing Lab.
**RADAR IMAGING APPLICATIONS: PAST, PRESENT,
AND FUTURE**

Richard K. Moore In AGARD Propagation Limitations in Remote Sensing Oct. 1971 19 p refs

Avail: NTIS HC \$6.00/MF \$0.95

Some of the proven applications of radar are outlined and future applications are suggested. Although restricted mostly to imaging systems, brief mention is made of the application of non-imaging radars to determining wind speeds over the oceans.

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Applications to be include: geology, geography, hydrology, bio-geography (including agriculture), oceanography, and cartography. Author

N72-16101# Naval Electronics Lab. Center for Command Control and Communications, San Diego, Calif.

REMOTE SENSING OF TROPOSPHERIC STRUCTURES USING HIGH RESOLUTION RADAR

J. H. Richter, E. E. Gossard, and D. R. Jensen /in AGARD Propagation Limitations in Remote Sensing Oct. 1971 13 p refs

Avail: NTIS HC \$6.00/MF \$0.95

A very sensitive, ultra high resolution radar has been developed for the purpose of studying the refractive index structure of the troposphere. The radar is a ground based, vertically pointing FM-CW-radar with a range resolution of one meter. The radar and its performance characteristics are described. The radar routinely detects layer structures in the lower troposphere. These layers are always associated with gradients in the vertical refractive index profile, and are frequently very thin, approaching the resolution of the radar. Very often they are perturbed by wave motions. Examples of various wave patterns are presented. Author

N72-16102# Wisconsin Univ., Middleton. Geophysical and Polar Research Center.

EFFECT OF BEAM WIDTH ON ACOUSTIC SIGNALS SCATTERED AT A ROUGH SURFACE

C. S. Clay and G. A. Sandness /in AGARD Propagation Limitations in Remote Sensing Oct. 1971 8 p refs

Avail: NTIS HC \$6.00/MF \$0.95

Underwater acoustic experiments were made in a laboratory tank in which the signals were scattered at a wind-blown surface. The rms roughness and spatial correlation function of the surface were measured by wave height probes. The ratio of the mean rectified signal scattered at the rough surface and that reflected at the smooth surface was measured for vertical incidence. Even though the surface was rough the mean rectified signal was inversely proportional to the source distance plus receiver distance. At large roughness the reflection-scattering function depends upon beam width and tends to the usual plane interface reflection function. Author

N72-16106# Lille Univ. (France). Lab. d'Optique Atmospherique. ANALYSIS OF RADIOMETRIC INFRARED MEASUREMENTS ON CLOUD TEMPERATURES AND STRUCTURES

Y. Fouquart and J. Lenoble /in AGARD Propagation Limitations in Remote Sensing Oct. 1971 8 p refs In FRENCH

Avail: NTIS HC \$6.00/MF \$0.95

The angular distribution of radiation intensity in a cloudy atmosphere is studied by the 4.3 micron carbon absorption band. Evaluation of the observed spectral frequencies shows that radiation transmission depends on the optical thicknesses of cloud layers. Transl. by G.G.

N72-16109# Kansas Univ., Lawrence. Center for Research, Inc.

EFFECT OF ANGULAR VARIATION ON TERRAIN SPECTRAL REFLECTIVITY

Dwight D. Egbert and Fawwaz T. Ulaby /in AGARD Propagation Limitations in Remote Sensing Oct. 1971 10 p refs

(Contract DAAK02-68-C-0089)

Avail: NTIS HC \$6.00/MF \$0.95

A technique is described that determines the optimum filter combinations and the feasibility of multiband photography in the visible and near infrared regions in planning remote-sensing missions. The test provides multispectral reflectivity curves not only for targets to be identified, but also for those backgrounds against which they are encountered. The procedure incorporates a method for determining spectral reflectance as a function of solar altitude, incidence look angle, and azimuth look angle. This

angular dependence of reflectivity is significant and an aid in detecting certain targets. It was found that for one target-background pair (asphalt and grass) the contrast ratio ranges from 2:1 to 0.5:1 under different angle conditions. Author

N72-16119# Kansas Univ., Lawrence. WORKSHOP ON RADAR SCATTERING HELD TUESDAY AFTERNOON 22 JUNE 1971

R. K. Moore /in AGARD Propagation Limitations in Remote Sensing Oct. 1971 7 p

Avail: NTIS HC \$6.00/MF \$0.95

Three topics are discussed. Radar backscatter from the sea, the need for microwave data on dielectric properties of natural surfaces and objects, and slant-range measurements by the nanosecondpulse radar. The most significant conclusion to emerge is that insufficient data are available on the dielectric constants of natural materials (ice, vegetation, soil) measured in situ. Author

N72-17132# Illinois Univ., Urbana. Dept. of Civil Engineering. GEOMETRIC ANALYSIS OF THE RBV TELEVISION SYSTEM

Kam W. Wong, Eugene V. Gamble, and Robert E. Riggins Jul. 1971 60 p refs

(Contract DI-14-08-0001-12631)

(PB-203705; UILU-ENG-71-2017; Rept-33) Avail: NTIS CSCL 17B

The geometric distortion characteristics and calibration problems of the return-beam vidicon television systems which will be flown on the Earth Resource Technology Satellites are studied. The overall objectives are: (1) to establish the magnitude, pattern and stability of geometric distortions in the RBV system; (2) to devise procedures and data reduction methods for the accurate calibration of the system's internal geometry; and (3) to provide accurate distortion and calibration data for detailed analysis of the potential mapping accuracy of the RBV imageries. Author (GRA)

N72-17270*# Scientific Translation Service, Santa Barbara, Calif.

TEMPERATURE MEASUREMENTS OF GROUND AND WATER SURFACES BY AIRCRAFT

D. Lorenz Washington NASA Feb. 1972 33 p refs Transl. into ENGLISH from Pure Appl. Geophys. (Basel), v. 67, 1967 p 197-220

(Contract NASw-2035)

(NASA-TT-F-14140) Avail: NTIS CSCL 08D

A description is given of the measurements made of ground and water surfaces using two different models of IR radiometers, the IT 1 and the PRT 4. The following results were reported: (1) sea-temperature measurements obtained by the IT 1 agreed well with the measurements of water temperature made by lightships, while they differed considerably from those made by coastal stations; (2) measurements of different types of surfaces indicated a strong influence exerted by the type of surface, particularly if covered with vegetation; and (3) measurements made at an angle between 30 and 45 deg to the horizontal yielded results which were not as dependent on the nature of the surface as were perpendicular measurements. Author

N72-17275*# National Aeronautics and Space Administration, Washington, D.C.

FIRST ESRO CONTRACTS FOR A EUROPEAN EARTH RESOURCE REMOTE DETECTION PROGRAM

P. Langereux Feb. 1972 3 p Transl. into ENGLISH from Air Cosmos (France), no. 416, Jan. 1972 p 30

(NASA-TT-F-14130) Avail: NTIS CSCL 08G

Four contracts were awarded for the establishment of a European experimental remote detection program that can be undertaken using airborne resources. Before beginning such a program it will be necessary to ascertain the usable means and their capabilities. Two of the contractors will study the possible uses of radiotelemetry with millimetric waves and side-looking radar, and the other two contractors will conduct an investigation to find an aircraft suitable for installation of remote detection equipment. Author

N72-17442# Geological Survey, Washington, D.C. Water Resources Div.

REMOTE SENSING BIBLIOGRAPHY FOR EARTH RESOURCES, 1969

J. P. Glasby and Dorothy G. Lowe Oct. 1970 198 p refs (PB-202726; USGS-WD-71-001) Avail: NTIS CSCL 08F

A compilation of 612 reference citations from 1969 literature is given in this bibliography, the fourth in a series of bibliographies on remote sensing. Technical material concerning methodology and applications for earth resources studies is cited, stressing advancements in airborne and earth satellite techniques. The citations cover nine subject categories and are arranged alphabetically by title under each category and in consecutive numerical order. Each item includes title, bibliographic citation, and a set of indexing descriptors. Indexes with applicable citation numbers are provided for author, corporate author, and subject terms. The cumulative subject term index at the end of the volume provides the necessary access to the key-word descriptors. The 70 journals searched for reference items are listed.

Author (GRA)

N72-17562# Israel Program for Scientific Translations, Ltd., Jerusalem.

PROBLEMS OF SATELLITE METEOROLOGY

I. P. Vetrov and G. I. Morskoi, eds. 1970 102 p refs Transl. into ENGLISH of Tr. Gidrometeorol. Nauchn.-Issled. Tsentr. SSSR (Leningrad), no. 36, 1968 Sponsored by ESSA and NSF (IPST-5669; TT-70-50001) Avail: NTIS

The processing, interpretation, and use of data collected by meteorological satellites for weather analysis and prediction is presented. Synoptic and dynamic meteorological methods as well as hydrometeorological applications are considered.

N72-18333*# California Univ., Berkeley.

ADDITIVE-COLOR IMAGE ENHANCEMENTS: TECHNIQUES AND EQUIPMENT

Jerry D. Lent *In its* Monitoring Earth Resources from Aircraft and Spacecraft 1971 p 9-14 ref
Avail: NTIS; SOD \$4.00 CSCL 20F

Some of the techniques and equipment used to extract information from multiband images through additive color image enhancement, are cited. Detailed descriptions are given of optical, electrical, multispectral, and combinations of electrical and optical systems. The limitations and advantages of such systems are discussed.

E.H.W.

N72-18339*# California Univ., Berkeley.

MULTISTAGE SAMPLING OF EARTH RESOURCES WITH AERIAL AND SPACE PHOTOGRAPHY

Philip G. Langley *In its* Monitoring Earth Resources from Aircraft and Spacecraft 1971 p 129-141 refs

Avail: NTIS; SOD \$4.00 CSCL 14E

The correlation of ground data with aerial and spaceborne photography to sample or catalog earth resources of large land areas is discussed. The effort was centered around an attempt to provide an inventory of natural resources, monitor crop development, locate new resource possibilities, and establish optimal distribution patterns. The variable probability sampling theory was used in the study.

E.H.W.

N72-18344*# Bellcomm, Inc., Washington, D.C.

CAPABILITIES OF THE SKYLAB-A SPECTROMETER (S191) FOR REMOTE SENSING OF SURFACE TARGETS IN THE THERMAL-INFRARED SPECTRAL REGION

R. W. Newsome, Jr. 20 Jan. 1972 66 p refs
(Contract NASw-417)

(NASA-CR-125671; TM-72-1011-2) Avail: NTIS CSCL 08G

The effects of some of the factors which fundamentally limit the amount of information which can be deduced from spectrometer (S191) measurements, made from the orbital altitude of Skylab-A, of the thermal-infrared power radiated into space from typical surface targets are discussed. The particular significance of this spectral region is that the power radiated at

night is comparable in intensity to that in daylight. Calculations were made which simulate the quality of spectrometer data that could be expected from spectral measurements made in space, of the thermal-infrared radiation emitted from typical rocks on the surface. The results indicate that the reststrahlen structure in these spectra is not distinctive enough to permit reliable identification of the rocks. This conclusion is confirmed by relevant data which have already been obtained from aircraft and spacecraft.

Author

N72-18450*# Geological Survey, Washington, D.C.

TESTING THE FRAUNHOFER LINE DISCRIMINATOR BY SENSING FLUORESCENT DYE

George E. Stoertz 1969 53 p

(NASA Order T-80485)

(NASA-CR-125653; USGS-IR-NASA-159) Avail: NTIS CSCL 14B

The experimental Fraunhofer Line Discriminator (FLD) has detected increments of Rhodamine WT dye as small as 1 ppb in 1/2 meter depths. It can be inferred that increments considerably smaller than 1 ppb will be detectable in depths considerably greater than 1/2 meter. Turbidity of the water drastically reduces luminescence or even completely blocks the transmission of detectable luminescence to the FLD. Attenuation of light within the water by turbidity and by the dye itself are the major factors to be considered in interpreting FLD records and in relating luminescence coefficient to dye concentration. An airborne test in an H-19 helicopter established feasibility of operating the FLD from the aircraft power supply, and established that the rotor blades do not visibly affect the monitoring of incident solar radiation.

Author

N72-18621*# Scientific Translation Service, Santa Barbara, Calif.

MICROMETEOROLOGIC TEMPERATURE MEASUREMENTS FROM AIRCRAFT

Dieter Lorenz Washington NASA Feb. 1972 12 p refs
Transl. into ENGLISH from Ann. Meteorol. (Offenbach am Main), no. 3, 1967 p 154-158
(Contract NASw-2035)

(NASA-TT-F-14139) Avail: NTIS CSCL 04B

Industrially manufactured radiometers were used for airborne surface temperature measurements of the earth. The practicality of these measurements in micrometeorology and mesometeorology is shown by some examples. It is found that this kind of measurement is highly influenced by the type of surface. This influence may be reduced if the measurements are taken at an inclination of 30 to 45 deg from the horizontal, rather than vertically.

Author

N72-19450# Colorado State Univ., Fort Collins. Dept. of Electrical Engineering.

THE USE OF COMPLEX DIELECTRIC CONSTANT AS A DIAGNOSTIC TOOL FOR THE REMOTE SENSING OF TERRESTRIAL MATERIALS

R. S. Vickers and G. C. Rose Aug. 1971 48 p refs

(Contract F19628-70-C-0035; AF Proj. 7260; Proj. Themis)

(AD-733322; AFCRL-71-0428; SR-5) Avail: NTIS CSCL 08/7

A basic problem in remote sensing is to find parameters which can be measured that can lead to a unique signature of given target materials. Two such parameters are the dielectric coefficient and conductivity of the material. In this report the feasibility of measuring the complex dielectric constant of a smooth material from an aircraft or satellite by measuring the reflection of an incident electromagnetic wave is investigated. The results of several experimental approaches to the remote measurement of complex dielectric constant are reported. The methods investigated include X band swept frequency reflectance measurements, dual polarization, and short pulse measurements. For measurements at frequencies above 100 MHz it is shown that the dielectric constant can be determined with plus or minus 10% by measurement of the real part of the complex reflection coefficient to plus or minus 0.3 db. It is further shown that the complex polarization method for determining the complex dielectric constant is not usable for angles of incidence near the normal.

Author (GRA)

08 INSTRUMENTATION AND SENSORS

N72-19516* Honeywell, Inc., Minneapolis, Minn. Aerospace Div.

ATTITUDE-REFERENCED RADIOMETER STUDY. PART 2: PRIMARY CALIBRATION SYSTEM

William R. Williamson and Allen A. Otte Washington NASA Dec. 1971 131 p refs
(Contract NAS1-8801)
(NASA-CR-1902) Avail: NTIS CSCL 14B

A primary calibration system, PCS, for infrared radiometers has been developed, built, and tested. The system allows radiometers to be calibrated with less than 1 percent error for use in earth coverage horizon measurements, earth resources surveys, and synoptic meteorological measurement. The final design, fabrication and test of the PCS are reported. A detailed description of the PCS construction is presented, along with the results of a complete series of functional tests. Test to verify the source thermal characteristics, collimator reflectance, and output beam characteristics are described and their results presented.

Author

N72-20409# Danish Meteorological Inst., Charlottenlund.

BIBLIOGRAPHY OF FLUXGATE MAGNETOMETERS

F. Primdahl 1971 16 p refs Reprinted from Publ. of the Earth Phys. Branch, v. 41, no. 1, of the Dept. of Energy, Mines, and Resources, Canada

(DMI-Geophys-Papers-R-22; ISBN-87-7478-039-5) Avail: NTIS
Papers on fluxgate magnetometers and closely related devices are listed. Most of the references include a short description of the contents under the following headings: type of sensor, theoretical calculations, experimental data, and instrument design and description. The major developments in the field from the early 1930's to the present are covered.

Author

N72-21163# Research Inst. of National Defence, Stockholm (Sweden).

MICROWAVE RADIOMETRY AND ITS POTENTIAL APPLICATION TO EARTH RESOURCES SURVEYS. KNOWLEDGE OF MATERIAL PROPERTIES NEEDED FOR ANALYSIS OF MICROWAVE RADIOMETRIC DATA

Torteiv Orhaug Linköping Saab Scania Dec. 1971 67 p refs
(Contract ESTEC-1411/71-EL)
(RAC-O-3-R16; ESRO-CR(P)-74) Avail: NTIS

The theory of thermal microwave noise generation from solids and gases is summarized. The influence of the various material properties is discussed, particularly for a conducting glossy object where the Fresnel coefficient can be used for predicting brightness properties. The effect and the characteristics of atmospheric noise are discussed and examples of microwave observations of atmospheric noise given. The scattering properties of an object having a rough surface are described with emphasis laid on the limitations of theoretical analysis. The generation of noise from rough surfaces is also treated. The polarization effect to be expected from glossy and rough surfaces is treated, and the influence of atmospheric noise discussed. The effects on thermal noise caused by sub-surface inhomogeneities and by time-varying heating are discussed. A summary of present programs and knowledge in this field is given, together with recommendations for future work.

Author (ESRO)

N72-21356* Stanford Univ., Calif. Remote Sensing Lab.
INFRARED SPECTROMETRY STUDIES. PHASE 4: EMITTANCE SPECTRA OF SELECTED TARGETS FROM MISSION 108 AIRBORNE DATA Final Report C, 1 Oct. 1970 - 31 Sep. 1971

R. J. P. Lyon 31 Oct. 1971 245 p refs
(Contract NAS9-7313)

(NASA-CR-115524; SU-RSL-71-6) Avail: NTIS CSCL 08G

Infrared radiance measurements from geological materials were studied. These involved laboratory and field spectroscopic measurements, both on the ground and airborne. A proven, feasible system is presented for airborne use over terrains with minimal vegetation. It has been shown that the spectral emittance concepts can be utilized in emittance ratio imagery which depicts the silicate composition of the terrain.

Author

N72-21394# Air Force Cambridge Research Labs., L. G. Hanson Field, Mass.

AFCL'S EXPERIMENTAL AERIAL GRAVIMETRY PROGRAM

Environmental Research Papers, Dec. 1965 - Mar. 1968
David Anthony and Robert M. Perry 27 Jul. 1971 40 p refs
(AF Proj. 7600)
(AD-735266; AFCRL-71-0411; AFCRL-ERP-366) Avail: NTIS CSCL 08/5

Between December 1965 and March 1968 AFCRL conducted a series of experimental aerial gravity measurements to determine the feasibility of large scale aerial gravity surveys. This report gives the results of the program and includes a program background, instrumentation description including the four gravimeters tested, upward continuation of gravity methods and evaluation in the test area, data processing procedures including corrections and smoothing methods applied, representative sample profiles, accuracy achieved in terms of profile and mean anomalies, and other aerial gravity tests and studies including helicopter gravity tests, a systems analysis of aerial gravimetry, and gravimetry by means of gradient measurements.

Author (GRA)

N72-22365* Stanford Univ., Calif. Remote Sensing Lab.

INFRARED SPECTROMETRY STUDIES: SPECTRAL DIGITAL DATA ACQUISITION SYSTEM (1971 VERSION)

Final Report (B), phase 4, 1 Oct. 1970 - 30 Sep. 1971
Lee Lu and R. J. P. Lyon 31 Oct. 1971 42 p refs
(Contract NAS9-7313)

(NASA-CR-115523; SU-RSL-71-3) Avail: NTIS CSCL 08G

The construction of the Stanford Spectral Digital Data Acquisition System is described. The objective of the system is to record both the spectral distribution of incoming radiation from the rock samples measured by the spectroradiometer (Exotech Model 10-34 Circular Variable Filter Infrared Spectroradiometer) together with other weather information. This system is designed for both laboratory and field measurement programs. The multichannel inputs (8 channels) of the system are as follows: Ch 1 the Spectro-radiometer, Ch 2 the radiometer (PRT-5), and Ch 3 to Ch 8 for the weather information. The system records data from channel 1 and channel 2 alternately for 48 times, before a fast sweep across the six weather channels, to form a single scan in the scan counter. The operation is illustrated in a block diagram, and the theory of operation is described. The outputs are written on a 7-track magnetic tape with IBM compatible form. The format of the tape and the playback computer programs are included. The micro-pac digital modules and a CIPHER model 70 tape recorder (Cipher Data Products) are used. One of the major characteristics of this system is that it is externally clocked by the spectroradiometer instead of taking data at intervals of various wavelengths by using internal-clocking.

Author

N72-22368* Aerojet-General Corp., El Monte, Calif. Space Div.

MICROWAVE RADIOMETRIC STUDIES AND GROUND TRUTH MEASUREMENTS OF THE NASA/USGS SOUTHERN CALIFORNIA TEST SITE

A. T. Edgerton, D. T. Trexler, S. Sakamoto, and J. E. Jenkins Apr. 1969 109 p Original contains color illustrations
(NASA Order W-12570; Contract DI-14-08-0001-11425)
(NASA-CR-126136; USGS-IR-NASA-149) Avail: NTIS CSCL 08G

The field measurement program conducted at the NASA/USGS Southern California Test Site is discussed. Ground truth data and multifrequency microwave brightness data were acquired by a mobile field laboratory operating in conjunction with airborne instruments. The ground based investigations were performed at a number of locales representing a variety of terrains including open desert, cultivated fields, barren fields, portions of the San Andreas Fault Zone, and the Salton Sea. The measurements acquired ground truth data and microwave brightness data at wavelengths of 0.8 cm, 2.2 cm, and 21 cm.

Author

N72-22411# Saab Aircraft Co., Linköping (Sweden). Missile and Electronics Div.

MICROWAVE RADIOMETRY AND ITS POTENTIAL APPLICATION TO EARTH RESOURCES SURVEYS: PHYSICAL BACKGROUND AND TECHNOLOGICAL IMPLEMENTATION

Sune Axelsson and Olov Edvardsson Oct. 1971 106 p refs (Contract ESTEC-1411/71-EL)

(ESRO-CR(P)-71; RAC-0-3-R15) Avail: NTIS

The physical principles of microwave radiometry are presented, and its application to satellite earth resources observation is discussed. The remote sensing of objects with temperature above absolute zero is limited by several factors, such as atmospheric attenuation, and interference from other radiation sources. This limits the choice of the observation frequency. Further error sources are output noise and limited resolution. A general survey is given of radiometer design, antenna types, and receivers. Displays are mentioned, and the characteristics of existing radiometers are given. ESRO

N72-22447# TRW Systems, Redondo Beach, Calif. Navigation and Optimization Section.

EARTH RESOURCES DATA SYSTEMS DESIGN: S192 INSTRUMENT MEASUREMENTS AND CHARACTERISTICS

A. S. Goldstein 14 Mar. 1972 46 p refs

(Contract NAS9-12330)

(NASA-CR-115499; TRW-20029-H060-R0-00) Avail: NTIS

CSCL 148

The design, development, and characteristics of the S192 instrument for use with the earth resources data systems are discussed. Subjects presented are: (1) multispectral scanner measurements, (2) measurement characteristics, (3) calibration and alignment, (4) operating modes, and (5) time tagging and references. The S192 will obtain high spatial resolution, quantitative line scan imagery data of the radiation reflected and emitted by selected test sites in up to 13 spectral bands of visible, near infrared, and thermal infrared regions of the electromagnetic spectrum. Author

N72-23281# Radio Corp. of America, Princeton, N.J. Astro-Electronics Div.

FRAME TYPE IMAGING SENSORS

George Barna In Princeton Univ. Proc. of the Princeton Univ. Conf. on Aerospace Methods for Revealing and Evaluating Earth's Resources Jun. 1970 20 p Sponsored by NASA

(NASA-CR-126422) Avail: NTIS HC \$3.00 CSCL 08G

The salient features of TV cameras for sensing natural and man-made earth resources from an orbiting satellite are discussed. The performance requirements for space cameras specifically designed for earth resources are examined, and the television systems currently being developed for first generation earth resource satellite missions are described. Author

N72-23282 Hughes Aircraft Co., Los Angeles, Calif.

SCANNING TYPE IMAGING SENSORS

Virginia T. Norwood In Princeton Univ. Proc. of the Princeton Univ. Conf. on Aerospace Methods for Revealing and Evaluating Earth's Resources Jun. 1970 8 p

Copyright. Avail: Issuing Activity

Multispectral scanners for space observations of earth resources are discussed, and the ATS spin-scan and the ERTS scanners are described. Satellite orbits and their relationship to altitude and times to complete earth coverage are considered. The constraints on resolution imposed by diffraction effects and space attitude control are examined. Earth resources imaging tasks are listed, and orbits and scanners which will best perform the tasks are suggested. It is concluded that scanners are presently practical for signature analysis and high resolution photographs. No orbit is satisfactory for all tasks. The fine detail imaging at monthly to annual frequency should be assigned to low ERTS type orbits and the coarser detail imaging needed more frequently should be assigned to geostationary spin scanners which can iterate observation several times an hour if necessary. Author

N72-23283# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

PASSIVE MICROWAVE SENSORS

Warren Hovis In Princeton Univ. Proc. of the Princeton Univ. Conf. on Aerospace Methods for Revealing and Evaluating Earth's Resources Jun. 1970 11 p ref

(NASA-TM-X-67710) Avail: NTIS HC \$3.00 CSCL 14B

Characteristics of passive microwave sensors and results taken by sensors on Convair 990 flights are discussed. Emissivities of different ground materials and water as vapor, liquid, and ice are described and the problems created by surface roughness are covered. Photographs taken of an ocean, vegetation around rivers, and a populated area are given and their details are described. N.E.N.

N72-23286# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

MANNED SYSTEMS FOR SENSING EARTH'S RESOURCES

John E. Dornbach In Princeton Univ. Proc. of the Princeton Univ. Conf. on Aerospace Methods for Revealing and Evaluating Earth's Resources Jun. 1972 35 p Original contains color illustrations

(NASA-TM-X-67711) Avail: NTIS HC \$3.75 CSCL 14B

The Gemini and Apollo photography, Earth Resources Aircraft Project, Apollo Applications Program dry workshop, and the space station/space base are discussed, concentrating on the conceptual sensors involved. Details are given on the single-camera and multiband systems used on the Gemini and Apollo flights, and high altitude aircraft and Apollo 9 photographs in red, green, and near infrared, taken during the same days, are compared. Sensors on NASA and Earth Resources aircraft include multiband and mapping cameras, scatterometer and side-looking radar, microwave radiometer and imager, and infrared spectrometer and radiometer, and scanner. The AAP sensors experiments contain four to six vacuum-back cameras with matched lenses, multichannel scanners, active/passive microwave system, and an infrared spectrometer. Plans for the astronaut activity with sensors in the space station/space base mission are outlined. N.E.N.

N72-23287# National Aeronautics and Space Administration, Washington, D.C.

UNMANNED SPACECRAFT FOR SURVEYING EARTH'S RESOURCES

Theodore A. George In Princeton Univ. Proc. of the Princeton Univ. Conf. on Aerospace Methods for Revealing and Evaluating Earth's Resources Jun. 1970 12 p

(NASA-TM-X-67712) Avail: NTIS HC \$3.00 CSCL 22B

The technical objectives and payloads for ERTS A and B are discussed. The primary emphasis is on coverage of the United States and the ocean areas immediately adjacent, using 3-camera return beam vidicon TV system, 4-channel multispectral point scanner, data collection system, and wideband video tape recorder. The expected performance and system characteristics of the RBV system and the 4-band multispectral object plane point scanner are outlined. Ground station considerations are also given. N.E.N.

N72-23303 Wisconsin Univ., Madison.

A REMOTE SENSING TECHNIQUE USING TERRESTRIAL REFRACTION, FOR THE STUDY OF LOW LEVEL LAPSE RATE Ph.D. Thesis

James King Sparkman, Jr. 1971 176 p

Avail: Univ. Microfilms Order No. 71-16902

By use of an appropriate target placed one to five km from the observer, data can be obtained photographically of the nearsurface terrestrial refraction over the path. The role of the density profile is examined, where the surface is assumed to be thermally homogeneous, and layers of equal density taken to be horizontal above a flat Earth. A monotonic density profile is shown to permit approximation of a ray equation, and thus the profile distribution, i.e., the density kernel, is seen to be the dominating factor in refraction, and hence of the target appearance as seen or photographed. Dissert. Abstr.

08 INSTRUMENTATION AND SENSORS

N72-23308# O'Brien (Brian), North Woodstock, Conn.
REMOTE SENSING OF THE EARTH SURFACE FROM AIRCRAFT AND SATELLITES
Brian O'Brien *In Comm. on Sci. and Astronaut. (U.S. House)*
Remote Sensing of Earth Resources 1972 p 19-23

Avail: SOD \$1.25

Principles of remote sensing of electromagnetic radiation from earth to sensor are discussed. Visible, infrared, and microwave types of radiation are considered. Electro-optical and photographic sensors are reviewed, as well as data transmission and handling. K.P.D.

N72-23309# Hughes Aircraft Co., El Segundo, Calif.
COMMENTS ON THE EARTH RESOURCES SENSING AND DATA ACQUISITION PROGRAM
Allen E. Puckett *In Comm. on Sci. and Astronaut. (U.S. House)*
Remote Sensing of Earth Resources 1972 p 25-41

Avail: SOD \$1.25

Effects of earth science and environmental quality discipline requirements are reviewed. Sensor development trends and their influence on sensor design, spacecraft platforms, and sensor data acquisition and communication elements for the support of the Earth Resources Observation and Management System are also discussed. K.P.D.

N72-23315# National Oceanic and Atmospheric Administration, Washington, D.C.
REMOTE SENSING OF EARTH RESOURCES AND ENVIRONMENT
Robert M. White *In Comm. on Sci. and Astronaut. (U.S. House)*
Remote Sensing of Earth Resources 1972 p 129-136

Avail: SOD \$1.25

Remote sensing from space platforms and aircraft is discussed in relation to programs of the National Oceanic and Atmospheric Administration. K.P.D.

N72-23639# Lockheed Missiles and Space Co., Palo Alto, Calif.
INTERRELATION BETWEEN THE DEVELOPMENT OF SYNOPTIC PROCESSES AND THE EVOLUTION OF AN INTEGRATED HUMIDITY FIELD BY SATELLITE MEASUREMENTS
E. P. Dombkovskaia and V. V. Demin [1972] 8 p refs Transl. into ENGLISH from Tr. Gidrometeo. Nauchno-Issled. Tsent. SSSR, no. 73, 1971 p 134-142
Avail: NTIS HC \$3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The possibility of a synoptic representation of data on the total moisture content of the atmosphere obtained from satellite data are discussed and illustrations of the synoptic interpretation of these data are described. A relationship between various synoptic formations and elements of the field is established along with the interrelationship between the synoptic process development and the changes in the integrated humidity field corresponding to this development. Data cover altitude and turbidity analysis charts, daily weather bulletins of Great Britain, and radiosonde data from 9 weather ships in the North Atlantic. Weather maps are included. Author

N72-24398* Wisconsin Univ., Madison.
AN ANNOTATED BIBLIOGRAPHY OF REMOTE SENSING AT THE UNIVERSITY OF WISCONSIN
Edmund R. Belak, Jr. Oct. 1970 16 p refs
(Grant NGL-50-002-127)
(NASA-CR-126639; Rept-2) Copyright. Avail: Wis. Univ., Madison, 351 Meteorology and Space Sci. Bldg.: HC \$2.00 CSCL 08G

A bibliography is presented on remote sensing programs conducted under the auspices of the University of Wisconsin. Topics studied included water quality management, watershed management, large water bodies, atmospheric effects, and remote imagery. K.P.D.

N72-24405* Wisconsin Univ., Madison. Dept. of Civil Engineering.
REFLECTANCE AND TRANSMITTANCE CHARACTERISTICS OF SELECTED GREEN AND BLUE-GREEN UNIALGAE
Lorne C. Gramms, William C. Boyle, and Edmund R. Belak, Jr., ed. Jul. 1971 28 p refs
(Grant NGL-50-002-127)
(NASA-CR-126631; Rept-5) Copyright. Avail: Wis. Univ., Madison, 351 Meteorology and Space Sci. Bldg.: HC \$2.00 CSCL 08A

Reflectance and transmittance characteristics were evaluated for two green algae, *Selenastrum* and *Chlorella*, and two blue-green algae, *Microcystis* and *Anabaena*, in the spectral region of 0.375 to 0.8 microns. Reflectance and transmittance properties were measured using a gamma spectrophotometer with a telescopic head attachment. The reflectance properties obtained were used to determine the feasibility of using selected wavelengths for differentiation between green and blue-green algae. Efforts were made to establish selected wavelengths and ratios which would delineate relative concentrations of the algal suspensions. Attenuation coefficients were calculated at selected wavelengths. The effects of nutrient level (uptake) and suspended particulates on reflectance and transmittance properties were also examined. Author

N72-24420* Geological Survey, Washington, D.C.
LABORATORY AND AIRBORNE TECHNIQUES FOR MEASURING FLUORESCENCE OF NATURAL SURFACES
George E. Stoertz and William R. Hemphill 1972 28 p refs
(NASA Order L-58514; NASA Order T-80485C)
(NASA-CR-126895; USGS-IR-NASA-237) Avail: NTIS HC \$3.50 CSCL 08G

Techniques are described for obtaining fluorescence spectra from samples of natural surfaces that can be used to predict spectral regions in which these surfaces would emit solar-stimulated or laser-stimulated fluorescence detectable by remote sensor. Scattered or reflected stray light caused large errors in spectrofluorometer analysis or natural sample surfaces. Most spurious light components can be eliminated by recording successive fluorescence spectra for each sample, using identical instrument settings, first with an appropriate glass or gelatin filter on the excitation side of the sample, and subsequently with the same filter on the emission side of the sample. This technique appears more accurate than any alternative technique for testing the fluorescence of natural surfaces. Author

N72-25324 Rice Univ., Houston, Tex.
ROCKET-BORNE MAGNETOMETER MEASUREMENT OF FIELD-ALIGNED CURRENTS ASSOCIATED WITH AN AURORAL ARC Ph.D. Thesis
Raymond John Park 1971 319 p
Avail: Univ. Microfilms Order No. 71-26335

A rocket-borne experiment to study the currents associated with a quiet auroral arc was conducted. The magnetic field near the arc was measured with a vector magnetometer system, while a lunar aspect sensor provided information on the orientation of the payload. The techniques for analyzing the magnetometer data to obtain the vector components of the magnetic field are described. The changes in magnetic field along the flight path were used to determine the most probable three-dimensional current system, which was concluded to be a northwestward electrojet and two oppositely directed sheet currents flowing along the geomagnetic field lines. The electrojet and the planes containing the field-aligned sheet currents were approximately parallel to the auroral arc. Dissert. Abstr.

N72-25347* National Academy of Sciences-National Research Council, Washington, D.C. Panel on Remote Atmospheric Probing.
ATMOSPHERIC EXPLORATION BY REMOTE PROBES. VOLUME 2: PROCEEDINGS OF SCIENTIFIC MEETINGS OF THE PANEL ON REMOTE ATMOSPHERIC PROBING
Final Report

Jan. 1969 710 p refs Conf. held at Chicago, 18-20 Apr. and 16-17 May 1968 Sponsored in part by AEC, ESSA, NSF, and PHS

(NASA Order W-12,596)

(NASA-CR-126787) Avail: NTIS HC \$37.50 CSCL 04A

Conference papers are presented dealing with methods and instrumentation capable of observing and measuring the physical composition and dynamical structure of the atmosphere from a distance.

N72-25348*# Dartmouth Coll., Hanover, N.H. Radiophysics Lab.

LINE OF SIGHT MICROWAVE PROPAGATION

John W. Strohbehn *In* NAS-NRC Atmospheric Exploration by Remote Probes, Vol. 2 Jan. 1969 p 1-20 refs

Avail: NTIS HC \$37.50 CSCL 20N

A review of the uses of microwave line-of-sight propagation in remote atmospheric probing is given. The review concentrates on use of the following types of measurements: (1) the use of total electrical path length for measuring average density and water vapor content; (2) the use of amplitude and phase fluctuations over a single path for determining the form of the turbulence spectrum; (3) the use of angle-of-arrival data for measuring the decrease in refractivity; and (4) the use of multiple-element receiving antennas in determining wind speed, atmospheric parameters, and atmospheric models. A review is given of the connection between microwave measurements and meteorological parameters, and the basic electromagnetic theory on which the analyses are made. A few suggestions for future work in these areas is given. Author

N72-25350*# Boeing Scientific Research Labs., Seattle, Wash. **ADDITIONAL LINE OF SIGHT METHODOLOGY TO THAT PRESENTED BY JOHN W. STROHBEHN IN THE USE OF LINE OF SIGHT MICROWAVE PROPAGATION IN REMOTE ATMOSPHERIC PROBING**

C. I. Beard *In* NAS-NRC Atmospheric Exploration by Remote Probes, Vol. 2 Jan. 1969 p 79-86 refs

Avail: NTIS HC \$37.50 CSCL 20N

Some additional microwave and infrared techniques are reported which are being tested in line-of-sight tropospheric scattering. Newly measured parameters of the incoherent scattered microwave field are sensitive to wavefront sphericity, to wind speed, and to the eddy wavenumber spectrum. A recommendation for advancing the state of the art is given by a proposed experimental program. Author

N72-25351*# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.

THE USE OF SATELLITE BEACONS FOR METEOROLOGICAL RESEARCH

Jules Aarons *In* NAS-NRC Atmospheric Exploration by Remote Probes, Vol. 2 Jan. 1969 p 89-90

Avail: NTIS HC \$37.50 CSCL 04A

The use of microwave beacon transmissions from synchronous and near synchronous satellites is discussed as a means of measuring atmospheric absorption. It is suggested that, with a fixed angle of elevation of a synchronous satellite, complete diurnal coverage of the integrated absorption is available. In addition, with refined interferometric equipment, angle of arrival studies can be made and phase deviations measured. D.L.G.

N72-25352*# Environmental Science Services Administration, Boulder, Colo.

REMOTE ATMOSPHERIC PROBING BY GROUND TO GROUND LINE OF SIGHT OPTICAL METHODS

Robert S. Lawrence *In* NAS-NRC Atmospheric Exploration by Remote Probes, Vol. 2 Jan. 1969 p 91-110 refs

Avail: NTIS HC \$37.50 CSCL 04A

The optical effects arising from refractive-index variations in the clear air are qualitatively described, and the possibilities are discussed of using those effects for remotely sensing the physical properties of the atmosphere. The effects include scintillations, path length fluctuations, spreading of a laser beam, deflection of the beam, and depolarization. The physical properties that may be measured include the average temperature along the path, the vertical temperature gradient, and the distribution along the path of the strength of turbulence and the transverse wind velocity. Line-of-sight laser beam methods are clearly effective in measuring the average properties, but less effective in measuring distributions along the path. Fundamental limitations to the resolution are pointed out and experiments are recommended to investigate the practicality of the methods. Author

N72-25355*# Sylvania Electronic Systems-East, Waltham, Mass.

INCOHERENT AND COHERENT CW LASER SYSTEMS FOR REMOTE ATMOSPHERIC PROBING

R. F. Lucy *In* NAS-NRC Atmospheric Exploration by Remote Probes, Vol. 2 Jan. 1969 p 125-132 refs

Avail: NTIS HC \$37.50 CSCL 20E

Typical laser systems now available for atmospheric probing are summarized. Experiments comparing coherent and incoherent receiving techniques are described and typical performance data presented. Author

N72-25373*# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering and Res. Lab. of Electronics.

PASSIVE REMOTE SENSING AT MICROWAVE WAVELENGTH

David H. Staelin *In* NAS-NRC Atmospheric Exploration by Remote Probes, Vol. 2 Jan. 1969 p 409-434 refs

(Grant NGR-22-009-016)

Avail: NTIS HC \$37.50 CSCL 04A

The ways in which radio signals are affected by meteorological parameters are described, as are methods for interpreting the signals, the state-of-the-art in instrumentation, the current state of development of the field, and some problems and prospects for the future. It is shown that the temperature profile of the atmosphere, water vapor and ozone distribution, cloud water content, and certain surface properties can be measured with sufficient accuracy to provide useful meteorological information. Author

N72-25377*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

EXPERIMENTAL APPROACHES TO REMOTE ATMOSPHERIC PROBING IN THE INFRARED FROM SATELLITES

William R. Bandeen *In* NAS-NRC Atmospheric Exploration by Remote Probes, Vol. 2 Jan. 1969 p 465-506 refs

Avail: NTIS HC \$37.50 CSCL 04A

Thirteen different types of radiometric instruments either were flown in orbit or are scheduled to fly on forthcoming satellites. A fourteenth type, a very high resolution radiometer for geosynchronous altitude, is among several of the others whose development was stressed for the Global Atmospheric Research Program. Characteristics of each radiometric instrument and some applications of the different types of data are discussed. Author

N72-25378*# Meteorological Service of Canada, Ottawa (Ontario).

SOME COMMENTS ON THE USE OF INFRARED RADIOMETRY FOR REMOTE ATMOSPHERIC PROBING

W. L. Godson *In* NAS-NRC Atmospheric Exploration by Remote Probes Jan. 1969 p 511-516

Avail: NTIS HC \$37.50 CSCL 04A

08 INSTRUMENTATION AND SENSORS

A critique is presented of the lead paper by L.D. Kaplan on infrared radiometry. The following topics are analyzed: the extent to which the desirable thermal resolution of the lower troposphere can be achieved, the effects of complex cloud structure on infrared data, the effective weighting function if linearization is possible, remote sounding from below the atmosphere, first-guess fields and operational techniques to blend satellite infrared data into a mix of data from various meteorological systems, a simple inversion procedure for thermal structure, and problems arising from cloud and haze layers of variable amount and emissivity.

Author

N72-25384*# Environmental Science Services Administration, Boulder, Colo. Research Labs.

ACOUSTIC METHODS OF REMOTE PROBING OF THE LOWER ATMOSPHERE

C. G. Little / In NAS-NRC Atmospheric Exploration by Remote Probes, Vol. 2 Jan. 1969 p 619-631 refs

Avail: NTIS HC \$37.50 CSCL 04A

The potential usefulness of acoustic methods for the remote probing of the lower atmosphere is reviewed. Starting with a comparison of the effects of temperature, wind, and humidity fluctuations upon the refractive index of air to electromagnetic and acoustic waves, it is shown that the fluctuations in acoustic refractive index may be expected to be about one thousand times stronger than in the radio case. Since the scattered power is proportional to the square of the refractive index fluctuations, the scatter of acoustic waves may be expected to be roughly one million times stronger than for radio waves. In addition, the million-fold ratio between the velocities of electromagnetic and acoustic waves results in an acoustic system requiring one million times less bandwidth to interrogate a given atmospheric volume.

Author

N72-25430# Joint Publications Research Service, Arlington, Va. GEOPHYSICAL EQUIPMENT

25 May 1972 75 p refs Transl. into ENGLISH from Geofizicheskaya Apparatura (Leningrad), nos. 45, 46, 47, 1971 (JPRS-56099) Avail: NTIS HC \$5.75

Articles are presented on various magnetometer designs for measuring weak and very weak magnetic fields and field components, errors and error analysis, and problems associated with airborne and shipborne measurements.

N72-25445# Marconi Space and Defence Systems, Ltd., Frimley (England).

A PRELIMINARY DESIGN STUDY FOR A MULTISPECTRAL IR LINE SCANNER FOR USE ON A RESEARCH AND APPLICATIONS MODULE, VOLUME 1

E. J. Becklake, comp. 19 Feb. 1972 102 p 2 Vol. (Contract ESTEC-1465-71-EL)

(Rept-779/72/1-Vol-1; ESRO-CR(P)-77) Avail: NTIS HC \$7.25

A preliminary design concept for a multispectral infrared line scanner for use with the post Apollo program space shuttle earth resources mission was produced and is described. It was found that it was in principle possible to meet the technical specification required, but that in certain cases the requirements are just on the borderline of feasibility. In order to meet the requirements, certain assumptions have had to be made on the future developments of components. For example, it was assumed that trimetal detectors will be available having 1/f noise cut-off frequencies of the order of 800 Hz. It was also assumed that the problems involved in the integration of the detectors, with the cooler cold fingers and the associated microphonically induced noise problems will be successfully solved.

Author (ESRO)

N72-25446# Marconi Space and Defence Systems, Ltd., Frimley (England).

A PRELIMINARY DESIGN STUDY FOR A MULTISPECTRAL IR LINE SCANNER FOR USE ON A RESEARCH AND APPLICATIONS MODULE, VOLUME 2

E. J. Becklake, comp. 19 Feb. 1972 57 p 2 Vol. (Contract ESTEC-1465-71-EL)

(Rept-779/72/1-Vol-2-Summ; ESRO-CR(P)-78) Avail: NTIS HC \$5.00

The preliminary design of a multispectral infrared line scanner for provisional use on a space shuttle CAN type mission is summarized. The design was aimed at a 7 day shuttle mission and very little consideration was given to the eventual use of the equipment in a space station with its 10 year mission. The basic technical specification can theoretically be met by this provisional design; however, the safety factor in certain channels should be reconsidered.

Author (ESRO)

N72-26273*# National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.

TECHNICAL KEYNOTE ADDRESS ON REMOTE SENSING Marvin R. Holter and Arch B. Park / In its Remote Sensing of the Chesapeake Bay 1972 p 5-47 ref Original Contains Color Illustrations

Avail: NTIS; SOD \$2.25 CSCL 08J

A review of remote sensing techniques is presented. Various types of remote sensors are described and the platforms used to mount the sensors are examined. Examples of remote sensing by aerial photography in infrared, ultraviolet, and visual spectra are included. The types of equipment are designated and their specific areas of application are defined. It is concluded that the primary objective of remote sensing is to contribute to man's ability to manage and use the terrestrial environment.

Author

N72-26315# Stockholm Univ. (Sweden).

MICROWAVE RADIOMETRY AND ITS POTENTIAL APPLICATION TO EARTH RESOURCES SURVEYS. PART 2: IDENTIFICATION, DESCRIPTION AND JUSTIFICATION OF APPLICATIONS

Gunnar Hoppe, Malin Falkenmark (Intern. Hydrol. Decade), Ulf Karstrom (Meteorol. and Hydrol. Inst.), Harald Svensson (Lund Univ., Swed.), and D. S. Parasnis (Uppsala Univ.) Linköping SAAB-Scania Feb. 1972 105 p refs (Contract ESTEC-1411-71-EL)

(RAC-0-3-R17; ESRO-CR(P)-75) Avail: NTIS HC \$7.25

Microwave radiometry is applied to the fields of agriculture (soils, vegetation, and forests), geography (physical and human), hydrology, oceanography, and geology. It is concluded that microwave radiometry has a great potential value for the application fields and that substantial efforts are justified to promote activities both in the study of different applications and regarding technological development. General recommendations are also given.

Author (ESRO)

N72-27352*# Geological Survey, Denver, Colo.

GEOLOGIC STUDIES OF YELLOWSTONE NATIONAL PARK IMAGERY USING AN ELECTRONIC IMAGE ENHANCEMENT SYSTEM

Harry W. Smedes May 1970 31 p refs Original contains color illustrations (NASA Order R-09-020-015)

(NASA-CR-127531; USGS-IR-NASA-181) Avail: NTIS HC \$3.75 CSCL 08G

The image enhancement system is described, as well as the kinds of enhancement attained. Results were obtained from various kinds of remote sensing imagery (mainly black and white multiband, color, color-infrared, thermal infrared, and side-looking K-band radar) of parts of Yellowstone National Park. Possible additional fields of application of these techniques are considered.

Author

N72-27354*# Techtran Corp., Glen Burnie, Md.

EXPERIMENTS ON A PROGRAM OF WORLD MAGNETIC SURVEY

Sh. Dolginov, V. I. Nalivayko, A. V. Tyurmin, and M. N. Chinchevov Washington NASA Mar. 1972 15 p refs Transl. into ENGLISH from "Issledovaniya Kosmicheskogo Prostranstva" Moscow, Nauka Press, 1965 p 606-614 (Contract NASw-2037)

(NASA-TT-F-14407) Avail: NTIS HC \$3.00 CSCL 08N

The desirability of having more accurate maps of the distribution and intensity of the earth's magnetic field is indicated. Use of proton magnetometers is stated to be the method of choice for determining the magnetic field at any point, preferably from relatively low-flying satellites in substantially

circular orbits. The mode of operation of such magnetometers is described briefly. Their operation in a satellite to yield data which can be either transmitted to an earth station or memorized is discussed. Evidence is given to show that spurious signals resulting from unfavorable orientation or deceptive signal to noise ratio can be identified and rejected. Anticipated future benefits to be attained by a systematic world survey of the magnetic field are indicated. Author

N72-27415 Department of Energy, Mines and Resources, Ottawa (Ontario). Earth Physics Branch.
BIBLIOGRAPHY OF MAGNETOMETER, VOLUME 43, NO. 8
P. H. Serson and F. Primdahl 1972 9 p refs
(M70-43/8) Copyright. Avail: Issuing Activity

A reference list of selected papers describing techniques and instruments for measuring the earth's magnetic field was prepared for the International Association of Geomagnetism and Aeronomy. It includes nearly 200 references, concentrating on developments since 1950 in methods of geomagnetic measurement. Author

N72-28378 Centre National d'Etudes Spatiales, Bretigny-sur-Orge (France).

AIRCRAFT AND BALLOON BORNE EXPERIMENTS [LES EXPERIENCES AVION ET BALLON]

L. Laidet *In its* Remote Sensing of Earth Resources Oct. 1971 p 7-32 In FRENCH Original contains color illustrations

Fundamental principles of remote sensing techniques are recalled, and experiments using aircraft or stratospheric balloon photography and infrared scanning are summarized. The instruments used in both imaging techniques are described, and the data processing procedures are outlined. The results from aircraft remote sensing of different French sites are reported. ESRO

N72-28379 Societe Europeenne de Propulsion, Puteaux (France).
BALLOON NACELLE FOR HIGH ALTITUDE PHOTOGRAPHY [NACELLE BALLON POUR PHOTOGRAPHIE A TRES HAUTE ALTITUDE]

L. Salter *In* CNES Remote Sensing of Earth Resources Oct. 1971 p 33-41 In FRENCH

The nacelle is described, designed for the balloon used for small scale scanning and multispectral photometry of the ground during the April 1971 flight. Special attention is paid to onboard equipment, including devices for automatic adjustment of photographic lens diaphragms and multispectral photomultiplier photometers. The calibration methods are reviewed. It is shown that balloon sounding is useful as the preliminary stage in the development of an earth resources satellite. ESRO

N72-28423# Utah State Univ., Logan. Electro-Dynamics Labs.
AIRCRAFTBORNE INSTRUMENTATION FOR AIRGLOW SURVEY Final Report, 15 Nov. 1970 - 14 Dec. 1971

Allan J. Steed and Ralph H. Haycock 14 Dec. 1971 19 p
(Contract F19628-71-C-0081; AF Proj. 5710)
(AD-739196; AFCRL-71-0594) Avail: NTIS CSCL 04/1

The Electro-Dynamics Laboratories of Utah State University has modified the AFCRL trainable-instrumentation mount originally fabricated by Cook Electric Company so that it can be used as a tracking platform for two Type-III interferometers and one radiometer. The modification basically involved the addition of vibration isolation mounts and an enclosure with temperature control for the entire system which will be mounted in a KC-135 aircraft 3120. A dual-channel radiometer was designed and fabricated to fit in the remaining available mount space after the two interferometers had been installed. In connection with the radiometer design, an existing AFCRL radiometer originally built by GCA was evaluated to determine its usefulness in making airglow measurements. In addition to the Cook mount

modifications, a manually trainable mount was fabricated to incorporate one interferometer, one radiometer and a 16-mm camera. Also, an NIR radiometer was modified to be used for hand-operated tracking and the rapid-scan spectrometer was updated to increase its sensitivity and reduce its noise level.

Author (GRA)

N72-28429# Scripps Institution of Oceanography, San Diego, Calif. Marine Physical Lab.

STUDY OF AIRBORNE TWO-WAVELENGTH RADIOMETER SYSTEM FOR TOTAL HEAT-FLOW MEASUREMENTS Final Report, 29 Jun. 1968 - 9 Nov. 1971

E. D. McAlister and Theodore D. Foster Nov. 1971 6 p refs
(Contract N62306-68-C-0258)
(AD-740092) Avail: NTIS CSCL 08/10

A two-wavelength radiometer system has been developed for measurement of the total heat flow through the sea surface from a low flying aircraft. The heat transfer in the top millimeter of the ocean was investigated theoretically and in the laboratory. This work provided a sound basis for the two-wavelength radiometric method of measuring total heat flow from the sea surface. GRA

N72-28457# California Univ., Riverside. Dept. of Geography.
PHOTOGRAPHIC FILMS AS REMOTE SENSORS FOR MEASURING ALBEDOS OF TERRESTRIAL SURFACES Final Report

Steven R. Pease (Wis. Univ., Milwaukee) and Robert W. Pease Mar. 1972 22 p refs
(NASA Order W-13265; USGS-14-08-001-11914)
(NASA-CR-127477; USGS-IR-NASA-225; TR-5) Avail: NTIS HC \$3.25 CSCL 14E

To test the feasibility of remotely measuring the albedos of terrestrial surfaces from photographic images, an inquiry was carried out at ground level using several representative common surface targets. Problems of making such measurements with a spectrally selective sensor, such as photographic film, have been compared to previous work utilizing silicon cells. Two photographic approaches have been developed: a multispectral method which utilizes two or three photographic images made through conventional multispectral filters and a single shot method which utilizes the broad spectral sensitivity of black and white infrared film. Sensitometry related to the methods substitutes a Log Albedo scale for the conventional Log Exposure for creating characteristic curves. Certain constraints caused by illumination geometry are discussed. Author

N72-28526# Defense Documentation Center, Alexandria, Va.
INFRARED LASERS Report Bibliography, Dec. 1961 - Dec. 1971

Apr. 1972 175 p refs
(AD-739900; DDC-TAS-72-4) Avail: NTIS CSCL 20/5

The bibliography deals with lasers operating in the infrared regions. Different types of molecular lasers are discussed with their frequencies. There are references on tunable lasers for air pollution detection, carbon dioxide lasers for 10.6 micron bands, monoxide lasers, chemical lasers, as well as references on techniques of lasing. Included are Corporate Author-Monitoring Agency, Subject, Title, and Personal Author Indexes.

Author (GRA)

N72-28633# Aerospace Corp., Los Angeles, Calif.
STUDY TO DEMONSTRATE THE FEASIBILITY OF, AND DETERMINE THE OPTIMUM METHOD OF REMOTE HAZE MONITORING BY SATELLITE Progress Report, 10-30 May 1972

Ernest H. Rogers, principal investigator 10 Jul. 1972 1 p
(Contract NAS5-21719)
(E72-10006; NASA-CR-127552; GSFC-ID-PR173;
ERTS-A-Proposal-SR-230) Avail: NTIS HC \$3.00 CSCL 04B

Author

08 INSTRUMENTATION AND SENSORS

N72-29301# Aerospace Engineering Test Establishment, Ottawa (Ontario).

CF-100 HIGH ALTITUDE REMOTE SENSING PROJECT Earth Resources CF-100 Handbook

[1972] 58 p. Compiled and amended monthly by AETE Uplands (Report-1000149) Avail: NTIS HC \$5.00

Photographic products from CF-100 high altitude remote sensing flights are presented and the potential of small angle imagery for mapping and natural resources application is considered. The aircraft operates at a 40,000 feet ceiling for about 2.5 hrs and carries multispectral cameras. G.G.

N72-29304* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

DEVELOPMENT OF EARTH RESOURCES SURVEY TECHNIQUES AT GSFC: OVERVIEW

W. Nordberg *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 2 p

CSSL 08G

Earth resources survey and remote sensing techniques under development at GSFC are reviewed. Emphasis is focussed primarily on: (1) definition and demonstration of remote sensing techniques which lead to the measurements of physical quantities from which earth resources related parameters can be determined; (2) development of sensors, spacecraft, and on-board as well as ground based data management systems; (3) determination of earth resources related parameters from the remote sensing observations and measurements; and (4) applications of earth observations to resource management. A.L.

N72-29319* National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

EARTH RESOURCES PROGRAMS AT THE LANGLEY RESEARCH CENTER. PART 1: ADVANCED APPLICATIONS FLIGHT EXPERIMENTS (AAFE) AND MICROWAVE REMOTE SENSING PROGRAM

Robert N. Parker *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 12 p

CSSL 08G

The earth resources activity is comprised of two basic programs as follows: advanced applications flight experiments, and microwave remote sensing. The two programs are in various stages of implementation, extending from experimental investigations within both the AAFE program and the microwave remote sensing program, to multidisciplinary studies and planning. The purpose of this paper is simply to identify the main thrust of the Langley Research Center activity in earth resources. Author

N72-29334* Michigan Univ., Ann Arbor.

MICHIGAN EXPERIMENTAL MULTISPECTRAL SCANNER SYSTEM

Philip G. Hasell, Jr. *In* NASA, Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 13 p

CSSL 08B

A functional description of a multispectral airborne scanner system that provides spectral bands along a single optical line of sight is reported. The airborne scanner consists of an optical telescope for scanning plane perpendicular to the longitudinal axis of the aircraft and radiation detectors for converting radiation to electrical signals. The system makes a linear transformation of input radiation to voltage recorded on analog magnetic tape. G.G.

N72-29335* Michigan Univ., Ann Arbor, Willow Run Labs.

MULTISPECTRAL IMAGING RADAR

L. J. Porcello and R. A. Rendleman *In* NASA, Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 18 p

(Contract NAS9-1106)

CSSL 171

A side-looking radar, installed in a C-46 aircraft, was modified to provide it with an initial multispectral imaging capability. The radar is capable of radiating at either of two wavelengths, these being approximately 3 cm and 30 cm, with either horizontal or vertical polarization on each wavelength. Both the horizontally- and vertically-polarized components of the reflected signal can be observed for each wavelength/polarization transmitter configuration. At present, two-wavelength observation of a terrain region can be accomplished within the same day, but not with truly simultaneous observation on both wavelengths. A multiplex circuit to permit this simultaneous observation has been designed. A brief description of the modified radar system and its operating parameters is presented. Emphasis is then placed on initial flight test data and preliminary interpretation. Some considerations pertinent to the calibration of such radars are presented in passing. Author

N72-29339* Kansas Univ./Center for Research, Inc., Lawrence. Remote Sensing Lab.

RADAR SIGNATURE AND SYSTEMS STUDIES AT KANSAS UNIVERSITY

Richard K. Moore *In* NASA, Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 37 p Original contains color illustrations

CSSL 171

The radar signature and systems studies described have concentrated in two areas: octave bandwidths radar spectrometry using a truck-mounted system, and scatterometry using primarily the 13.3 GHz system on aircraft. In addition, the results of the experiments to date have been synthesized into a pair of representative designs for spacecraft radar systems: one for small spacecraft and one for large spacecraft. Author

N72-29349* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

MEASUREMENTS PROGRAM IN REMOTE SENSING AT PURDUE UNIVERSITY

LeRoy F. Silva *In* NASA, Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 33 p refs

(Grant NGL-15-005-112)

CSSL 14B

The measurements program has been concerned with five basic research areas during 1971. These areas are: (1) The influence of haze layers upon remotely sensed surface properties; (2) electrical methods of soil moisture measurement; (3) thermographic studies of vegetation under nutritional stress; (4) improved field spectroradiometry; and (5) biological spectrophotometry. All of these projects have risen out of problems generated from the overall laboratory mission. The emphasis in this paper is on instrumentation and techniques. Author

N72-29354* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. POLARIZATION EFFECTS WITH A COMBINED RADAR-RADIOMETER

David Martin *In* NASA, Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 12 p

CSSL 14B

Described is a unique microwave sensor. The device uses a coherent X-band radar, a radiometer at the same wavelength and an antenna with a polarization that can be varied electronically. This microwave sensor was developed to acquire polarization signature information about various surfaces in both the active and passive mode simultaneously. One application for the sensor is expected to be the location and identification of plant life. Author

N72-29391* Florida Univ., Gainesville. Dept. of Coastal and Oceanographic Engineering.

LABORATORY INVESTIGATIONS RELATED TO MI- CROWAVES

Omar H. Shemdin *In* NASA, Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 4 21 Jan. 1972 21 p refs

CSSL 08C

The investigation in a laboratory controlled environment was of the structure of the water surface and the immediate layers above and below the surface. The scope included: (1) the investigation of the capillary waves and their interaction with gravity waves, (2) the formation of whitecaps at different wind speeds and the influence of gravity waves on whitecaps, and (3) the wind-generated spray under different wind and wave conditions. Author

N72-29410* Maine Univ., Orono. Dept. of Botany.
THE USE OF KODAK AEROCHROME INFRARED COLOR FILM, TYPE 2443, AS A REMOTE SENSING TOOL
G. R. Cooper, R. L. Bowen (Agricultural Res. Serv., Weslaco, Tex.), and H. W. Gausman (Agricultural Res. Serv., Weslaco, Tex.) *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 6 p refs
Original contains color illustrations

CSCL 14E

An infrared color film, Kodak Aerochrome, type 2443, has replaced the 8443 film. The 2443 has lower contrast than the 8443 film, and allows deeper probing into areas that appear as solid black shadows on the 8443 film. The cyan layer of 2443 is approximately 1 1/2 stops slower, at a density of 1.4, than the yellow and magenta emulsion layers. Author

N72-29412* Agricultural Research Service, Weslaco, Tex. Soil and Water Conservation Research Div.
DISCRIMINANT ANALYSES OF BENDIX SCANNER DATA

A. J. Richardson, C. L. Wiegand, R. W. Leamer, A. H. Gerbermann, and R. J. Torline *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Review, Vol. 5 21 Jan. 1972 22 p refs

CSCL 09B

Flights over Weslaco, Texas are discussed, using the 9-channel Bendix scanner, providing calibrated data in the 380 to 1000 nm wavelength interval. These flights were at 2000 ft. These data gave seasonal coverage from the time signals, representing mainly the soil background. The ground truth data are provided; signature processing studies relating scanner data to ground truth were also carried out. Author

N72-29419* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex. Earth Observations Aircraft Program Office.

AIRCRAFT DATA ACQUISITION

Ronald K. Blilie *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Review, vol. 5 21 Jan. 1972 9 p

CSCL 02C

The corn blight project was different than previously planned missions in duration, coverage, and sensor configuration. The wide aerial coverage and single sensor configuration provided flexibility in mission operations that contributed to mission success. This project also provided a review of the data on a timely basis permitting sensor corrections to be made and evaluated in the field. Author

N72-29461# TRW Systems Group, Redondo Beach, Calif.
EMISSION AND REFLECTION FROM ANISOTROPIC RANDOM ROUGH SURFACES

Philip J. Lynch and Richard J. Wagner Mar. 1972 68 p refs
(Contract N00014-71-C-0240; NR Proj. 387-051)
(AD-741705; TRW-17608-6005-RO-00) Avail: NTIS CSCL 08/10

A geometrical-optics theory of emission and scattering from anisotropic random rough surfaces is developed. A complete ray treatment is provided in the sense that multiple-scatter and bistatic shadowing effects are included in a consistent manner for a general two-dimensionally rough surface. It is also shown that, in the context of this theory, both upper and lower bounds

exist to the effects of surface roughness on the emissivity. A numerical calculation of the emissivity for a perfect conductor provides a check on the theory against a known result, and the scattering theory is shown to conserve energy to a relatively high degree of approximation when double-scatter effects are included. Predictions of the emission theory for the thermal microwave emission from the sea surface are compared with the results of earlier theories. Author (GRA)

N72-29470# Hoverproducts Ltd., Ottawa (Ontario).
CARSP: EXPLORATORY SYSTEMS STUDY INVESTIGATING THE SUITABILITY OF AEROSTATS FOR REMOTE SENSING PLATFORM APPLICATIONS
Leonard X. Pomerleau 20 Nov. 1970 165 p Sponsored by Geol. Survey of Canada
(HPL Proj. H-038-1)
Avail: NTIS HC \$10.25

Remote sensing denotes an activity performed by a system: a combination of men, material and techniques operating in concert and having a specific function. One of the major components of such a system is the platform which supports the sensor instrumentation at a vantage height above the planet surface. In this study, it is demonstrated that self-propelled aerostats capable of controlled flight and station keeping at various elevation can be designed and that these show many advantages over other types of platforms which are presently being considered for use or which are being used in remote sensing operations. Author

N72-30329 General Aniline and Film Corp., Binghamton, N.Y.
GAF COLOR FILMS FOR SPECIAL REMOTE SENSING APPLICATIONS

Ira B. Current *In* Texas A&M Univ. Proc. of the Symp. on Remote Sensing in Marine Biol. and Fishery Resources Mar. 1971 p 173-193 refs

Three types of GAF color aerial film are described and the conditions under which each is best suited for use in photographing beneath water surfaces are discussed. The types considered are: GAF 200 and 500 color aerial film, and GAF 1000 blue insensitive color aerial film. A.L.

N72-30343* Massachusetts Inst. of Tech., Cambridge.
METEOROLOGICAL AND ECOLOGICAL MONITORING OF THE STRATOSPHERE AND MESOSPHERE
Reginald E. Newell and Carlton R. Gray Washington NASA Aug. 1972 166 p refs
(Contract NAS1-9884)
(NASA-CR-2094; AER-12-F) Avail: NTIS HC \$3.00 CSCL 04A

A concept for determining the constituent densities of ozone, atomic oxygen, aerosols, and neutral density in the 20 to 1000 km region of the atmosphere from a satellite was developed. The concept includes the daytime measurement of solar scattering at the earth's limb in selected narrow spectral bands of the ultraviolet and visible regions, and the measurement of selected (dayglow) emissions. Nighttime measurements of the atmospheric extinction of stellar energy in selected bands are also considered as are simultaneous measurements of the 5577 airglow and molecular oxygen emission in the Herzberg band. Radiative-transfer models and recursive inversion algorithms are developed for the measurements, and the accuracy of the concept is assessed. Author

N72-31340* General Electric Co., Philadelphia, Pa.
QUICK LOOK ANALYSIS OF LOS ANGELES TEST SITE SCENE WITH GENERAL ELECTRIC MULTISPECTRAL INFORMATION EXTRACTOR SYSTEM (GEMS)
Surendra Anant Raje, Principal Investigator and Richard Economy 29 Sep. 1972 2 p Presented as Preliminary Findings from Analyses of ERTS Observations, NASA Goddard Space Flight Center, Greenbelt, Md., 29 Sep. 1972
(Contract NAS5-21797)
(E72-10049; NASA-CR-128051) Avail: NTIS HC \$3.00 CSCL 08H

08 INSTRUMENTATION AND SENSORS

N72-31360* Aerospace Corp., Los Angeles, Calif.
STUDY TO DEMONSTRATE THE FEASIBILITY OF AND DETERMINE THE OPTIMUM METHOD OF REMOTE HAZE MONITORING BY SATELLITE Progress Report, 1 Jun. - 31 Jul. 1972

Ernest H. Rogers, Principal Investigator 31 Jul. 1972 1 p
 (Contract NAS5-21719)
 (E72-10078; NASA-CR-128093) Avail: NTIS HC \$3.00 CSDL 04B

N72-31375# Gregory (Alan F.), Ottawa (Ontario).
WHAT DO WE MEAN BY REMOTE SENSING?
 Alan F. Gregory 1972 5 p refs Presented at 1st Can. Symp. on Remote Sensing, Ottawa, Feb. 1972
 Avail: NTIS HC \$3.00

A formal division is proposed between remote sensing as a means of collecting data, and the information system that attaches significance to them. Further delineation, based on physical principles, results in the following definition: Remote sensing denotes the aerospace practices of surveying the ultraviolet, visible, infrared and microwave radiations emitted and reflected from the surface of the earth (or any plant). Author

N72-31376# Canada Centre for Remote Sensing, Ottawa (Ontario).
A REVIEW OF SATELLITE AND AIRCRAFT REMOTE SENSING INSTRUMENTATION
 J. MacDowall 7 Feb. 1972 67 p Presented at the Can. Symp. on Remote Sensing, Ottawa, 7 Feb. 1972
 Avail: NTIS HC \$5.50

A review is presented of earth resource sensors which are available or under development. Information on sensor characteristics is given so that the user can select the most appropriate available system for use. Developments in Canada are introduced indicating fruitful areas for instrumentation development and techniques with particular promise. Author

N72-31377# Department of Energy, Mines and Resources, Ottawa (Ontario). Program Planning Office.
CF-100 HIGH ALTITUDE REMOTE SENSING PROJECT
 F. A. Godby [1971] 7 p
 Avail: NTIS HC \$3.00

This project was initiated for the purposes of: (1) investigating the potential of high altitude, small scale imagery for mapping and natural resources application, and (2) obtaining simulated spacecraft imagery. The vehicle used is a CF-100 aircraft, outfitted as a camera platform to meet the experimental and test requirements of the Department of National Defence. The first flight was conducted on 19 May 1970 over Lake Ontario. Author

N72-31415# Virginia Univ., Charlottesville.
THE APPLICATION OF IMAGE SENSING ARRAYS TO METROLOGY, DETECTION AND INSTRUMENTATION Final Report
 Eugene S. McVey, Edward A. Parrish, Jr., and Gerald Cook May 1972 130 p refs
 (Contract DAAK02-71-C-0075)
 (AD-743233; EE-3314-104-72U; ETL-CR-72-5) Avail: NTIS CSDL 08/2

The report covers the second year of research on what is intended to be a relatively long-term effort devoted to the study of the application of image sensing arrays and related problems. A major portion of the effort has been to further the understanding of applying perturbation to improve performance of sensor arrays. Future work will continue to be concerned with delineating the limits of this technology. It is intended that these techniques shall ultimately be applied to the processing of maps and map information. Author (GRA)

N72-31435# Kansas Univ., Lawrence. Center for Research.
PROJECT THEMIS: A CENTER FOR REMOTE SENSING
 Semiannual Technical Report, Sep. 1971 - Mar. 1972
 F. T. Ulaby, comp. Mar. 1972 58 p refs

(Contract DAAK02-68-C-0089; Proj. Themis)
 (AD-743234; CRES-TR-133-28; ETL-CR-72-4; SATR-9) Avail: NTIS CSDL 17/9

The report summarizes the technical progress under the subject contract on a broad interdisciplinary effort for the improvement of user utility of remotely sensed data. This effort involves theoretical work, sensor development, processing and display, and data analysis for specific user application. A number of technical reports and memoranda describing work underway are attached. Author (GRA)

N72-31444 + Department of Energy, Mines and Resources, Ottawa (Ontario).
SENSORS

Dennis White 1971 61 p refs
 (Rept-10) Copyright. Avail: NTIS Avail: Issuing Activity

The conclusions and recommendations of the working group on sensors regarding the identification of those parameters and physical variables that have relevance to a Canadian resource satellite and airborne sensing program are discussed. Although efforts were made to identify significant parameters and physical quantities prior to soliciting and evaluating development program proposals, a more extensive study of user needs was made to provide guidance and direction for future sensor developments. A user parameter study was conducted to articulate the needs of the user groups and provide a framework for evaluating sensor research and development to Canadian requirements and future programs. User groups and sensor development groups were brought together in organized workshops. Following the workshop discussions, proposals were called from 64 potential bidders; 53 of whom submitted proposals. Eleven contracts were subsequently placed and comprise 12 programs. Author

N72-31447# Forest Management Inst., Ottawa (Ontario).
LARGE SCALE AERIAL PHOTOGRAPHY AND RADAR ALTIMETRY: THE STATE OF THE ART
 L. Sayn-Wittgenstein [1972] 10 p refs Presented at 15th IUFRO Congr., Florida, Mar. 1971
 Avail: NTIS HC \$3.00

The feasibility of using large scale aerial photography coupled with specially designed radar altimeters for forest inventories is investigated. Test results show that technically such a system can be employed. E.H.W.

N72-32189# Lincoln Lab., Mass. Inst. of Tech., Lexington.
BACKSCATTER FROM A MOVING TARGET IN A RANDOMLY FLUCTUATING SLAB APPLICATION TO A VEGETATED ENVIRONMENT
 Shalom Rosenbaum 28 Apr. 1972 47 p refs
 (Contract F19628-70-C-0230; ARPA Order 1559)
 (AD-744049; TN-1972-2; ESD-TR-72-103) Avail: NTIS CSDL 17/9

The stochastic nature of the target return depends on numerous factors: the spatial randomness of the forest's EM parameters, their temporal fluctuations, the target size and its state of motion. Attention is focused upon the calculation of the mean power and the temporal spectrum of the target return, quantities of direct and obvious relevance. The spectral modifications are traceable to two first order factors: (1) the motion of the scattering centers within the random vegetation slab and (2) the target motion through a randomly inhomogeneous field, with the latter likely to dominate. The analysis is carried out within the framework of the so-called distorted wave born approximation. The incoherent (random) scattering is accounted for to the order of single scatter, while coherent (background) effects such as refraction at the air-vegetation interface and ground reflections are properly considered. Author (GRA)

N72-32346* Geological Survey, St. Louis, Mo.
PERFORMANCE OF THE ERTS DATA COLLECTION SYSTEM IN A TOTAL SYSTEM CONTEXT Progress Report, 1 Jul. - 31 Aug. 1972
 James F. Daniel, Principal Investigator 5 Sep. 1972 24 p
 Sponsored by NASA
 (E72-10093; NASA-CR-128142) Avail: NTIS HC \$3.25 CSDL 05B

N72-32451 National Lending Library for Science and Technology, Boston Spa (England).

THE INFLUENCE OF BACKGROUND COMPENSATION IN X-RAY RADIOMETRIC LOGGING

V. A. Meier et al Jul. 1972 8 p refs Transl. into ENGLISH from Uch. Zap. Leningr. Gos. Univ., Ser. Fiz. i Geol. Nauk (Leningrad), v. 19, no. 346, 1969 p 61-69

(NLL-RTS-6739) Avail: Natl. Lending Library, Boston Spa, Engl.: £0.80

The effectiveness of using background compensation in X-ray radiometric logging was tested under working conditions with tin. Results show use of such compensation provides the possibility of linear diagram averaging in the spectral proportions and improves the accuracy of qualitative determinations in the RRR probe. E.H.W.

N72-32466# Lockheed Missiles and Space Co., Palo Alto, Calif. SOME RESULTS OF SPECTROPHOTOMETRY OF NATURAL FORMATIONS FROM THE MANNED SOYUZ-9

K. Ia. Kondratev, A. A. Buznikov, O. B. Vasilev, B. V. Vinogradov, V. M. Orlov, V. I. Sevastianov, and O. I. Smoktii [1972] 12 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 10, no. 2, 1972 p 245-254

Avail: NTIS HC \$3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Results are presented of spectrophotometry of natural formations on the earth's surface, based on data obtained by the manual RSS-2 spectrograph, on the manned Soyuz 9 spacecraft. The results are compared with those obtained from ground-based spectrophotometers. Author

N72-33338# Saab Aircraft Co., Linköping (Sweden). Missiles and Electronics Div.

MICROWAVE RADIOMETRY AND ITS POTENTIAL APPLICATION TO EARTH RESOURCES SURVEYS. VOLUME 5: THEMATIC BIBLIOGRAPHY

Sune Axelsson, comp. Jun. 1972 56 p refs (Contract ESTEC-1411/71-EL)

(RL-0-3-R5; ESRO-CR(P)-126) Avail: NTIS HC \$5.00

The bibliography is based on reports, articles, and other documents taken from TPA, STAR and IAA during 1962-1970, and consists of standard bibliographic information plus keywords. The following sections are included: applications, land surfaces, water surfaces, material properties, technology and methodology, sensors, and data processing and analysis. Author (ESRO)

N72-33368# East Tennessee State Univ., Johnson City. BIBLIOGRAPHY OF REMOTE SENSING APPLICATIONS FOR PLANNING AND ADMINISTRATIVE STUDIES

Nelson R. Nunnally Dec. 1971 76 p refs Sponsored by Geol. Survey Prepared for TVA

(PB-209633; USGS-DO-72-008; USGS-IR-234) Avail: NTIS HC \$4.85 CSCL 13B

The annotated bibliography is representative of the material available, both published and unpublished, and covers the entire spectrum of application in terms of methodology, techniques, and procedures, and all types of sensing systems. It is selective in that the authors have attempted to respect the best of articles covering the same application, and to present different viewpoints. GRA

N72-33529# General Electric Co., Philadelphia, Pa. Missile and Space Div.

DESIGN CONSTRUCTION AND EVALUATION OF A MOBILE LIDAR SYSTEM FOR THE REMOTE MEASUREMENT OF SMOKE PLUME OPACITY Final Report, 24 Dec. 1969 - 21 Dec. 1971

C. S. Cook and G. W. Bethke Dec. 1971 100 p refs (Contract EPA-68-02-0093)

(PB-210672; APTD-0968) Avail: NTIS HC \$3.00 CSCL 13B

A mobile (truck mounted) ruby laser lidar system has been designed, constructed and evaluated for the remote measurement of smoke plume opacity (or transmittance). The system has been

tested at ranges of 211 and 319 meters using synthetic targets of known laboratory measured transmittance. The targets used were made of bright and black anodized aluminum screen, glass, plexiglass, white painted plywood and black felt. These tests indicated an error which increased as target reflectance increased. In general, the lidar and telephotometer determined transmittance values agreed within the accuracy expected for a given plume transmittance as indicated by the synthetic target test results. Plume-to-sky contrast (plume visibility) was found to have no correlation with plume transmittance because of the variability of ambient illumination of the plume. GRA

N72-33965 National Aeronautical Establishment, Ottawa (Ontario). Flight Research Lab.

GRADIENT COMPENSATION

C. D. Harduck /in NRC of Can. Quart. Bull. of the Div. of Mechanical Eng. and the Natl. Aeron. Estab. 30 Jun. 1972 p 1-14

The problem caused by the earth magnetic field gradient in airborne magnetic anomaly detecting systems is discussed. A system to compensate for the gradient effects is described. The effects of aircraft maneuvers on the detection range of the magnetic anomaly detector is analyzed. Author

N73-10370*# Servicio Geologico de Bolivia, La Paz.

EARTH RESOURCES TECHNOLOGY SATELLITE DATA COLLECTION PROJECT ERTS-A BOLIVIA Progress Report, Jul. - Oct. 1972

Carlos E. Brockmann, Principal Investigator Oct. 1972 5 p Sponsored by NASA

(E72-10191; NASA-CR-128389) Avail: NTIS HC \$3.00 CSCL 08B

N73-10417# Caribbean Research Inst., St. Thomas (Virgin Islands).

INCIDENT AND REFLECTED SOLAR RADIATION IN A TROPICAL ENVIRONMENT Final Report, 1 Feb. 1970 - 31 Jan. 1972

John B. Adams, Jean D. Larsen, and Richard M. Bond 1 Feb. 1972 94 p refs

(Contract F19628-70-C-0014; AF Proj. 7628)

(AD-743931; AFCRL-72-0096) Avail: NTIS CSCL 08/6

Field measurements were made of incident and reflected radiation on the island of St. Croix, U.S. Virgin Islands (lat. 17 degrees 45 min. N). Climatic zones of St. Croix range from desert to tropical rain forest. Field measurements were supplemented by laboratory data and by aerial photography. Spectral reflectance measurements were made of the major types of rocks, soils and vegetation. The main rock types are readily identified by their reflectance properties, whereas the soils are less distinctive. Trees and other plants are difficult to identify by optical properties alone. Enhanced irradiation is common at certain solar angles from orographically controlled cumulus streets and from the sea surface. Radiation under a tropical forest canopy assumes the spectral distribution of chlorophyll. Visible wavelengths are strongly attenuated and near-infrared radiation may be dominant. Author (GRA)

N73-10434# Geological Survey, Washington, D.C.

VISIBLE FLUORESCENCE OF EARTH SURFACE MATERIALS AND POTENTIAL APPLICATIONS IN REMOTE SENSING Final Report

George F. Stoertz 1972 62 p refs

(PB-210621; USGS-DO-72-010) Avail: NTIS HC \$3.00 CSCL 08G

Fluorescence emission spectra of 368 samples analyzed by improved techniques demonstrate that a wide range of important materials on the earth's surface display appreciable fluorescence when irradiated by rays present in the sun's spectrum. Spectrofluorometer analyses of samples from the Atacama Desert, from Iran, and from the Great Basin confirm that the floors of desert basins are commonly encrusted by minerals that emit moderately intense fluorescence. Although spectral differences among common surface materials may be small, they appear to be sufficient to serve as a basis for discriminating them by means of an advanced airborne fluorescence sensor such as a Fraunhofer line discriminator. Author (GRA)

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N73-10484# Tetra Tech, Inc., Pasadena, Calif.
THREE COLOR INFRARED RADIOMETER Final Report. 21
Jun. 1971 - 15 Feb. 1972
Marion Todd and Willard Wells Jul. 1972 27 p ref
(Contract N00014-72-C-0015; ARPA Order 1920)
(AD-745004) Avail: NTIS CSCL 08/10

A three-color infrared radiometer, intended primarily for examining the thermal radiance from the sea with maximum sensitivity for small temperature differences was designed. The radiometer operates in wavelength bands matched to the three most transparent atmospheric windows in the infrared, namely 2.3, 3.8, and 10 microns. Its thermal sensitivity in the two longer-wavelength bands equals the expected mean background thermal noise level. The radiometer was developed for an experiment to detect internal ocean waves through their radiometric effects. GRA

N73-10861*# Techtran Corp., Glen Burnie, Md.
THERMAL SOUNDING EXPERIMENT BY THE METEOR ARTIFICIAL EARTH SATELLITE
L. A. Pakhomov, Yu. M. Timofeyev, V. G. Shklyarevskiy, and O. M. Pokrovskiy Washington NASA Jul. 1972 10 p refs
Transl. into ENGLISH from Meteorol. i Gidrol. (Moscow), no. 12, 1971 p 25-30
(Contract NASw-2037)
(NASA-TT-F-14493) Avail: NTIS HC \$3.00 CSCL 22C

On the basis of the experiment with the spectrometer of the Central Aerological Observatory, installed aboard the Meteor satellite, a possibility of successful solution of the problem of temperature remote sounding with the aid of spectral measurements of medium resolution is demonstrated. The retrieval of a medium resolution is performed under conditions of a cloudless atmosphere as well as in overcast conditions. The prospect of methods of remote sounding under conditions of partial cloudiness is demonstrated. A statistical retrieval of the moisture profile is performed. Author

N73-11307*# Arizona Univ., Tucson. Optical Sciences Center.
DETERMINATION OF THE INFLIGHT OTF OF ORBITAL EARTH RESOURCES SENSORS
P. N. Slater, Principal Investigator and R. A. Schowengerdt Oct. 1972 23 p refs Presented at 9th Congr. of the Intern. Comm. for Optics, Santa Monica, Calif.
(Contract NAS5-21849; NAS9-9333)
(E72-10212; NASA-CR-128483) Avail: NTIS HC \$3.25 CSCL 14E

There are no author-identified significant results in this report. A technique has been investigated that is particularly applicable to evaluation of earth-orbiting multispectral sensors. In all programs employing such sensors, simultaneous underflight photography from aircraft is made during passes of the spacecraft. To evaluate the spacecraft imagery, the two sets of photographs are scanned and digitized with a microdensitometer. The data are then Fourier analyzed, and the spatial frequency spectra is calculated. The spatial frequencies in the underflight trace are scaled to those in the spacecraft trace, and the ratio of the spectra gives the in-flight optical transfer function (OTF) for the orbiting sensor. The method has been applied to an Apollo 9 frame and the sensor OTF has been calculated. The results are good enough to encourage use of the technique and to indicate the accuracies required of the various measurements involved in determining in-flight sensor OTF by this method. A technique for determining correct scan registration and scaling between the two sets of imagery and a promising approach to noise reduction, in the form of weighted averaging of OTF's, are discussed. A.L

N73-11387# Communications Research Centre, Ottawa (Ontario).
MICROWAVE RADIOMETRY FOR SURVEILLANCE FROM SPACECRAFT AND AIRCRAFT
A. W. Adey Feb. 1972 30 p refs
(CRC-1231) Avail: NTIS HC \$3.50

The status of current airborne and satellite remote sensing programs based on microwave radiometers is reviewed. Details

of instrumentation capabilities and limitations are given and research areas and problems where these devices have application are outlined. A bibliography is included. Author

N73-12401# Elliott-Automation Space and Advanced Military Systems, Ltd., Camberley (England).
SIDE-LOOKING RADAR SYSTEMS AND THEIR POTENTIAL APPLICATION TO EARTH RESOURCE SURVEYS. VOLUME 3: POTENTIAL APPLICATIONS OF SLR TO THE REMOTE SENSING OF EARTH RESOURCES
Aug. 1972 174 p refs 4 Vol.
(Contract ESTEC-1537/71/EL)
(ESRO-CR(P)-138) Avail: NTIS HC \$10.75

The SLR applications to the remote sensing of earth resources are reviewed for a number of disciplines: geography, agriculture, forestry, geology, hydrology, oceanography, and transportation. In each case, the background and physical characteristics of the discipline are given followed by the present status of SLR within the disciplines. Potential applications are discussed, and recommendations for an experimental program are given. For Vol. 1 see 91458; Vol. 2, 91459; Vol. 4, 91481. For individual titles, see N73-12402 through N73-12409.

N73-12402 Elliott-Automation Space and Advanced Military Systems, Ltd., Camberley (England).
SIDE-LOOKING RADAR AND THE EARTH SCIENCES
R. J. Haslam *In its* Side-looking Radar Systems and their potential Appl. To Earth Resource Surveys, Vol. 3 Aug. 1972 p 2-7 refs

The advantages and disadvantages of SLR are outlined with regard to its application in remote sensing of earth resources. The interpretation of SLR imaging is discussed, and the state of the art in SLR equipment is summarized. Author (ESRO)

N73-12405 Reading Univ. (England).
GEOGRAPHICAL APPLICATIONS OF SIDE-LOOKING RADAR
R. A. G. Saviegar *In* Elliott-Automation Space and Advan. Mil. Systems Side-Looking Radar Systems and their potential Appl. To Earth Resource Surveys, vol. 3 Aug. 1972 p 42-63 refs

The background to the discipline of geography is explained, and the present status of radar imagery used in landscape study, is reviewed. Potential geographical applications of SLR in Europe and the world are considered, and recommendations for an experimental program are outlined. Author (ESRO)

N73-12418# Elliott-Automation Space and Advanced Military Systems, Ltd., Camberley (England).
SIDE-LOOKING RADAR SYSTEMS AND THEIR POTENTIAL APPLICATION TO EARTH RESOURCE SURVEYS. VOLUME 1: BASIC PRINCIPLES OF SIDE-LOOKING RADAR
R. A. Deane Aug. 1972 137 p refs 7 Vol.
(Contract ESTEC-1537/71/EL)
(ESRO-CR(P)-136-Vol-1) Avail: NTIS HC \$9.00

The principles and usage of real and synthetic side-looking radar are described. With particular emphasis on their use in the earth resource sciences. Principles, installation, and operation of the radar in an aircraft or satellite are outlined. The mapping both of static terrain and of moving vehicles is considered. A brief summary is included of atmospheric losses and terrain reflections at microwave frequencies. For Vol. 2 see ESR-91459; for Vol. 3 see ESR-91460; for Vol. 4 see ESR-91461.

Author (ESRO)

N73-12419# Elliott-Automation Space and Advanced Military Systems, Ltd., Camberley (England).
SIDE-LOOKING RADAR SYSTEMS AND THEIR POTENTIAL APPLICATION TO EARTH RESOURCE SURVEYS. VOLUME 4: DATA PROCESSING AND INTERPRETATION REQUIREMENTS
R. A. Deane and R. J. Haslam Aug. 1972 111 p refs 7 Vol.
(Contract ESTEC-1537/71/EL)
(ESRO-CR(P)-139-Vol-4) Avail: NTIS HC \$7.75

The optical and digital data processing of SLR imagery from both aircraft and satellite platforms is discussed, including the processing for both real and synthetic aperture radar systems. The subsequent handling of the imagery for identification and automatic classification purposes is also described.

Author (ESRO)

N73-12730* Stanford Univ., Calif. Remote Sensing Lab. **NEW FORMAT PRESENTATION FOR INFRARED SPECTRAL EMITTANCE DATA. INFRARED SPECTROMETRY STUDIES, PHASE 5** Final Report, 1 Sep. 1971 - 30 Sep. 1972
R. J. P. Lyon and A. A. Green 30 Sep. 1972 157 p refs
(Contracts NAS9-7313; NAS2-3402)
(NASA-CR-128646; RSL-TR-72-2) Avail: NTIS HC \$10.00 CSDL 14B

Methods for infrared radiance measurements from geological materials were studied for airborne use over terrains with minimal vegetation. The tasks of the investigation were: (1) calculation of emittance ratios, (2) comparison of IR spectral emittance data with K-band scatterometer data over Pissgah Crater, and (3) standard infrared spectral file. Published papers reporting the research are included. F.O.S.

N73-13332 Michigan Univ., Ann Arbor. **INFRARED RADIANT TEMPERATURES IN THE ALPINE/PERIGLACIAL ENVIRONMENT AS RELATED TO THERMAL REMOTE SENSING** Ph.D. Thesis
Ray Leonard Lougeay 1971 124 p
Avail: Univ. Microfilms Order No. 72-4925

Observations were conducted in the St. Elias Mountains, Yukon Territory, Canada to determine some aspects of the applicability of thermal remote sensing in the alpine/periglacial environment. Techniques of ground truth observations were tested by which a researcher might determine the usefulness of infrared scanning to his study without the financial investment of airborne remote sensing on a trial-and-error basis. Also, an attempt was made to determine the environmental controls upon radiant temperature by monitoring changing patterns of radiant temperature relative to changing meteorologic conditions. Observations of both actual and thermal infrared radiant temperatures were made over various environmental surfaces in the alpine/periglacial environment. The techniques developed proved useful in predicting the best time for thermal remote sensing overflight and in indicating the intensity of ground truth observations needed at that time. Dissert. Abstr.

N73-13843* Allied Research Associates, Inc., Concord, Mass. **SATELLITE OBSERVATIONS OF TEMPORAL TERRESTRIAL FEATURES**

George Rabchevsky In NASA. Marshall Space Flight Center Space for Mankind's Benefit 1972 p 155-179 refs

CSDL 05F

N73-14338* Arizona Univ., Tucson. **EVALUATION OF ERTS-1 IMAGE SENSOR SPATIAL RESOLUTION IN PHOTOGRAPHIC FORM** Progress Report, 1 Nov. 1972 - 1 Jan. 1973

Philip N. Slater, Principal Investigator and R. A. Schowengerdt Jan. 1973 10 p
(Contract NAS5-21849)
(E72-10350; NASA-CR-129663; PR-2) Avail: NTIS HC \$3.00 CSDL 14E

There are no author-identified significant results in this report. Progress on obtaining ERTS-1 and simultaneous U2 underflight imagery is discussed. In addition, several microdensitometer scans of pseudo-edges in frame 1104-17393 are presented and discussed in reference to the project objectives. The effects of ERTS-1 scan lines on image studies are described quantitatively.

N73-14354* Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div. **RADIANT POWER MEASURING INSTRUMENT (RPMI)** New

Technology Report

Robert H. Rogers, Principal Investigator 8 Jan. 1973 8 p
(Contract NAS5-21863)
(E72-10366; NASA-CR-129799; BSR-3498) Avail: NTIS HC \$3.00 CSDL 14B

There are no author-identified significant results in this report. The radiant power measuring instrument is a rugged, hand-carried instrument which provides an ERTS investigator with a capability of obtaining radiometric measurements needed to determine solar and atmospheric parameters that affect the ERTS radiance measurements. With these parameters, ERTS data can be transformed into absolute target reflectance signatures, making accurate unambiguous interpretations possible.

N73-14381* Scientific Translation Service, Santa Barbara, Calif. **PROBLEMS IN THE UTILIZATION OF RADIOPHYSICAL METHODS FOR STUDYING THE EARTH'S ATMOSPHERE AND SURFACE WITH SPACECRAFT**

Yu. K. Khodarev, Ye. Bessalova, Yu. N. Pashin, G. D. Polyanina, A. L. Serebryakyan, I. A. Strukov, O. F. Shakhno, Ye. A. Sharkov, and V. S. Etkin Washington NASA Dec. 1972 66 p refs
Transl. into ENGLISH of "Vopr. Primeneniya Radiofiz. Metoov Diya Izuch. Atmosfery i Poverkhn. Zemli s Pomoshchyu Kosmich. Apparatov", Rept. Pr-112 Inst. for Space Res., Acad. Sci. USSR, Moscow, 1972 50 p
(Contract NASw-2035)
(NASA-TT-F-14642; Pr-112) Avail: NTIS HC \$5.50 CSDL 04A

Problems of applying radiophysical methods to investigating the earth's resources are studied. The problems which may be studied by radiophysical methods are outlined, the initial achievements toward solving these problems are noted, and classes of radiophysical systems designed to investigate the earth's resources are considered. Author

N73-14430* Hughes Aircraft Co., El Segundo, Calif. Space and Communications Group. **MULTISPECTRAL SCANNER SYSTEM FOR ERTS: FOUR BAND SCANNER SYSTEM. VOLUME 2: ENGINEERING MODEL PANORAMIC PICTURES AND ENGINEERING TESTS** Final Report

Aug. 1972 93 p Original contains color illustrations
(Contract NAS5-11255)
(NASA-CR-130111; HS-324-5214-Vol-2; SCG-20529R-Vol-2) Avail: NTIS HC \$6.75 CSDL 14B

This document is Volume 2 of three volumes of the Final Report for the four band Multispectral Scanner System (MSS). The results are contained of an analysis of pictures of actual outdoor scenes imaged by the engineering model MSS for spectral response, resolution, noise, and video correction. Also included are the results of engineering tests on the MSS for reflectance and saturation from clouds. Finally, two panoramic pictures of Yosemite National Park are provided. Author

N73-14443* ITT Aerospace/Optical Div., Fort Wayne, Ind. **MULTI-SPECTRAL IMAGE DISSECTOR CAMERA SYSTEM** Final Report

20 Oct. 1972 89 p Original contains color illustrations
(Contract NAS5-11617)

(NASA-CR-130131) Avail: NTIS HC \$6.50 CSDL 14E

The image dissector sensor for the Earth Resources Program is evaluated using contrast and reflectance data. The ground resolution obtainable for low contrast at the targeted signal to noise ratio of 1.8 was defined. It is concluded that the system is capable of achieving the detection of small, low contrast ground targets from satellites. F.O.S.

N73-15198* Elliott-Automation Space and Advanced Military Systems, Ltd., Camberley (England).

SIDE-LOOKING RADAR SYSTEMS AND THEIR POTENTIAL APPLICATION TO EARTH RESOURCE SURVEYS. VOLUME 7: BIBLIOGRAPHY

R. J. Haslam Aug. 1972 110 p refs
(Contract ESTEC-1537/71-EL)

08 INSTRUMENTATION AND SENSORS

(ESRO-CR(P)-142-Vol-7; Ref-5795-Vol-7) Avail: NTIS HC \$7.50

References relevant to side-looking radar as a remote sensor for earth resources are listed. The following subject areas are included: agriculture, forestry, geography, geology, hydrology, oceanography, data processing, terrain analysis, and photointerpretation. Author and subject indexes are given. The references are also stored on magnetic tape. Author (ESRO)

N73-15200# Elliott-Automation Space and Advanced Military Systems, Ltd., Camberley (England).

SIDE-LOOKING RADAR SYSTEMS AND THEIR POTENTIAL APPLICATION TO EARTH RESOURCE SURVEYS. VOLUME 8: SUMMARY

Aug. 1972 145 p

(Contract ESTEC-1537/71-el)

(ESRO-CR(P)-141) Avail: NTIS HC \$9.25

A summary is given of a study whose purpose is to inform earth scientists on the application of side-looking radar to the remote sensing of earth resources. The aspects summarized are: the basic principles of side-looking radar; radar scattering from natural surfaces; data handling and analysis; application of side-looking radar in the earth sciences; and required research and development. Appendices include a history of side-looking radar, frequency band designations, and a list of applications.

Author (ESRO)

N73-15377* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

DESIGN CONSIDERATIONS FOR A SPACE-BORNE OCEAN SURFACE LASER ALTIMETER

Henry H. Plotkin /in NOAA Sea Surface Topography from Space, Vol. 1 Feb. 1972 27 p refs

08-13)

CSCL 14B
Design procedures for using laser ranging systems in spacecraft to reflect ocean surface pulses vertically and measure spacecraft altitude with high precision are examined. Operating principles and performance experience of a prototype system are given. E.H.W.

N73-15386* National Aeronautics and Space Administration. Wallops Station, Wallops Island, Va.

THE SKYLAB RADAR ALTIMETER

H. Ray Stanley and J. T. McGoogan /in NOAA Sea Surface Topography from Space, Vol. 1 Feb. 1972 10 p refs

CSCL 14B

A summary of the significant hardware characteristics of the S-193 altimeter experiment portion of the 1973 Skylab Mission is presented. A detailed discussion of the altimetry, oceanographic, and instrumentation technology objectives are presented along with a discussion of the major experiments associated with these objectives. Author

N73-15427# Utah State Univ., Logan. Electro-dynamics Labs. **LWIR (LONG WAVELENGTH INFRARED) ATMOSPHERIC TRANSMISSION MEASUREMENTS USING AIRCRAFT-BORNE INTERFEROMETRIC INSTRUMENTATION** Final Report, 15 May 1970 - 15 Mar. 1972

Arthur Corman, Richard Higgins, and Ron Huppi 14 Apr. 1972 37 p refs

(Contract F19628-70-C-0249; AF Proj. 7670)

(AD-749876; AFCRL-72-0253) Avail: NTIS CSCL 04/1

The work performed under this contract consisted of the design and fabrication of a calibration system and a temperature control system to be installed on an airborne interferometer. A heliostat and interferometer system was calibrated and operated on-board a KC-135 research aircraft during several flights for the purpose of initial check out and in-flight testing. The data gathered were reduced to spectra for evaluation of the overall system performance. Author (GRA)

N73-15482* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

DIGEST OF NASA EARTH OBSERVATION SENSORS

Robert R. Drummond Dec. 1972 328 p Prepared by IIT Res. Inst.

(NASA-TM-X-66144; X-733-72-464) Avail: NTIS HC \$18.50 CSCL 14B

A digest of technical characteristics of remote sensors and supporting technological experiments uniquely developed under NASA Applications Programs for Earth Observation Flight Missions is presented. Included are camera systems, sounders, interferometers, communications and experiments. In the text, these are grouped by types, such as television and photographic cameras, lasers and radars, radiometers, spectrometers, technology experiments, and transponder technology experiments. Coverage of the brief history of development extends from the first successful earth observation sensor aboard Explorer 7 in October, 1959, through the latest funded and flight-approved sensors under development as of October 1, 1972. A standard resume format is employed to normalize and mechanize the information presented. Author

N73-16321* Bureau of Reclamation, Denver, Colo.

MONITOR WEATHER CONDITIONS FOR CLOUD SEEDING CONTROL Progress Report, 1 Jul. - 1 Nov. 1972

Archie M. Kahan, Principal Investigator 8 Jan. 1973 2 p

(NASA Order S-70243-AG-8)

(E73-10059; NASA-CR-130309) Avail: NTIS HC \$3.00 CSCL 04B

N73-16353* Geological Survey, Washington, D.C.

AEROSPACE METHODS OF REVEALING AND EVALUATING EARTH RESOURCES

William A. Fischer /in NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 1 1972 p 39-53

CSCL 08E

The design rationale for the Earth Resources Technology Satellites is presented. The user agency information needs and progress in information extraction are discussed. The ability of the ERTS system to provide repetitive data so that changes in the distribution of earth resources with time may be easily detected is emphasized. Examples of aerial photography are included to explain the data extraction processes. P.N.F.

N73-16354* Geological Survey, Washington, D.C.

REMOTE SENSING IN GEOLOGY, HYDROLOGY, AND GEOGRAPHY

Charles J. Robinove /in NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 1 1972 p 55-66

CSCL 08F

The application of remote sensing from aircraft and spacecraft to acquiring data on geology, hydrology, and geography of earth areas is discussed. The facilitation of mineral resources exploration by space imagery is explained. Earth resources data obtained during the Apollo 9 flight and the Gemini flights are analyzed. The use of color infrared and black and white infrared photography for mapping and resource management is demonstrated. The organization and functions of the U.S. Geological Survey geography program are presented. P.N.F.

N73-16360* Purdue Univ., Lafayette, Ind. Lab. for Application of Remote Sensing.

SYSTEMS APPROACH TO THE USE OF REMOTE SENSING David A. Landgrebe /in NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 1 1972 p 139-154

CSCL 14B

The earth resources information system which uses satellites as sensor platforms is discussed. The information is derived by sensing and analyzing the spectral, spatial, and temporal variations of electromagnetic fields emanating from the earth's surface. The multispectral approach and pattern recognition are described as examples of data analysis procedures for numerically oriented systems. The steps necessary in using a pattern recognition scheme are described and illustrated with data

obtained from the Apollo 9 flight. Both manual and machine-aided training techniques are described for the pattern recognition algorithm. Author

N73-16372* Centre National d'Etudes Spatiales, Paris (France). **THE FRENCH TELEDETECTION PROGRAM**
Aime Alouges /in NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 1 1972 p 235-236

CSCL 14B

Organizations for conducting remote sensing and earth resources projects in France are identified. Emphasis is placed on the aerial photography and photointerpretation of data for selected areas of Europe. The location of various test sites is identified and the nature of their activities is reported. P.N.F.

N73-16373* Michigan Univ., Ann Arbor.

INTRODUCTION TO SENSORS

Gwynn H. Suits /in NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 1 1972 p 239-243

CSCL 14B

Various types of remote sensors are described. Important sensor types are identified as: (1) photographic camera, (2) video camera, (3) optical-mechanical scanner, and (4) microwave radar. Radiation properties which these sensors measure are summarized and their respective methods of operation are illustrated. A block diagram of a typical remote sensing system is provided. Author

N73-16374* Radio Corp. of America, New York.

TELEVISION CAMERAS

Otto H. Schade, Sr. /in NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 1 1972 p 245-261 refs

CSCL 17B

The characteristics of television cameras for use as remote sensors are presented. Camera design and operation are discussed in detail and illustrated by photographs. The performance of the improved television cameras is compared with that of photographic film cameras. Author

N73-16375* National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, Tex.

AERIAL CAMERAS, AERIAL FILMS, AND FILM PROCESSING

Richard W. Underwood /in its Intern. Workshop on Earth Resources Surv. Systems, Vol. 1 1972 p 263-276 refs

CSCL 14E

The characteristics of aerial cameras and their employment in remote sensor investigations are reported. The development and use of the multispectral camera is discussed. The properties and applications of photographic films for various types of aerial photography are analyzed. Equipment and techniques for processing film are described. P.N.F.

N73-16376* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

EARTH OBSERVATION SENSORS

William Nordberg /in its Intern. Workshop on Earth Resources Surv. Systems, Vol. 1 1972 p 277-281

CSCL 14B

The characteristics of sensors for earth observation are discussed. The design depends on the required sensitivity, spectral resolution, spatial resolution, and geographic coverage. Comparisons are made between the sensors for the Skylab program and those for the Earth Resources Technology Satellite. Examples of compromises in the design of sensors to meet specific requirements are examined. Author

N73-16377* Kansas Univ./Center for Research, Inc., Lawrence. **RADAR AND MICROWAVE RADIOMETRY**

Richard K. Moore /in NASA, Washington Intern. Workshop on

Earth Resources Surv. Systems, Vol. 1 1972 p 283-301

CSCL 17I

The characteristics of radar and microwave radiometry and their application to earth resources survey activities are discussed. The use of radar for topographic mapping, geologic mapping, and geomorphic representation is described. Additional use of radar for mapping crops and natural vegetation, land use, soil moisture, and snow analysis is reported. The response of radar scatterometers and microwave radiometers to wind speed on the ocean is analyzed. Examples are provided for several uses of microwave sensors. Author

N73-16379* Geological Survey, Washington, D.C.

REMOTE SENSING AND TIME VARIANT PHENOMENA

Robert H. Alexander /in NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 1 1972 p 327-341

CSCL 14B

The application of airborne remote sensors for detecting environmental changes at and near the earth's surface is discussed. The studies of environmental changes are analyzed in the context of their relationship to cyclic and evolutionary processes at work in the environment. An example is provided to illustrate ways that remote sensing monitoring systems can be incorporated into operational information systems for observing changes that take place in the course of regional or national economic development. Author

N73-16489* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

MINIMUM DISTANCE CLASSIFICATION IN REMOTE SENSING

A. G. Wacker (Saskatchewan Univ.) and D. A. Landgrebe 9 Feb. 1972 26 p refs Presented at 1st Can. Symp. for Remote Sensing, Ottawa, 7-9 Feb. 1972

(Grant NGL-15-005-112)

(NASA-CR-130030; LARS-Print-030772) Avail: NTIS HC \$3.50 CSCL 14B

The utilization of minimum distance classification methods in remote sensing problems, such as crop species identification, is considered. Literature concerning both minimum distance classification problems and distance measures is reviewed. Experimental results are presented for several examples. The objective of these examples is to: (a) compare the sample classification accuracy of a minimum distance classifier, with the vector classification accuracy of a maximum likelihood classifier, and (b) compare the accuracy of a parametric minimum distance classifier with that of a nonparametric one. Results show the minimum distance classifier performance is 5% to 10% better than that of the maximum likelihood classifier. The nonparametric classifier is only slightly better than the parametric version. Author

N73-16494* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

A THREE STAGE SAMPLING MODEL FOR REMOTE SENSING APPLICATIONS

Ludwig M. Eisgruber [1972] 28 p refs

(Grant NGL-15-005-112)

(NASA-CR-130026; Inform-Note-021072) Avail: NTIS HC \$3.50 CSCL 14E

A conceptual model and an empirical application of the relationship between the manner of selecting observations and its effect on the precision of estimates from remote sensing are reported. This three stage sampling scheme considers flightlines, segments within flightlines, and units within these segments. The error of estimate is dependent on the number of observations in each of the stages. G.G.

N73-16495* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

THE IMPORTANCE OF GROUND TRUTH DATA IN REMOTE SENSING

Roger M. Hoffer [1972] 13 p, refs, Presented at UN Panel

08 INSTRUMENTATION AND SENSORS

Meeting on the Estab. and Implementation of Res. Programs in Remote Sensing, San Jose dos Campos, Brazil, 29 Nov. - 10 Dec. 1971.

(Grant NGL-15-005-112)
(NASA-CR-130020; LARS-Print-120371) Avail: NTIS HC \$3.00 CSCL 14E

Surface observation data is discussed as an essential part of remote sensing research. One of the most important aspects of ground truth is the collection of measurements and observations about the type, size, condition and other physical or chemical properties of importance concerning the materials on the earth's surface that are being sensed remotely. The use of a variety of sensor systems in combination at different altitudes is emphasized. F.O.S.

N73-16968 Consiglio Nazionale delle Ricerche, Milan (Italy). Lab. per la Geofisica della Litosfera.

MEASUREMENT OF THE THERMAL INFRARED FIELD: FIRST APPLICATIONS TO GEOPHYSICS IN ITALY [LE MISURE NEL CAMPO DELL'INFRAROSSO TERMICO: PRIME APPLICAZIONI ALLE SCIENZE DELLA TERRA IN ITALIA] c13

R. Cassinis, G. M. Lechi, and A. M. Tonelli / In Ist. Univ. Navale Selected Papers on Oceanog., Meteorol., Geophys., and Atmospheric Jun. 1972 p 243-252 In ITALIAN

The theoretical principles of infrared spectroscopy and the interest of this technique applied to remote sensing of earth resources are outlined. The equipment, which includes radiometers and scanners, is described. Data recorded from 6 to 16 April 1970 using an infrared scanner in the 8 to 14 micron range to study the Solferata di Pozzuoli area are presented. Results obtained from data on volcanology of the Eolian Islands recorded during May 1970 and data on radiance anomalies recorded during remote sensing of Solferata di Pozzuoli are also given. ESRO

N73-17307* Bureau of Reclamation, Denver, Colo.

MONITOR WEATHER CONDITIONS FOR CLOUD SEEDING CONTROL Progress Report, 1 Jul. - 31 Dec. 1972

Archie M. Kahan, Principal Investigator 17 Jan. 1973 14 p (NASA Order S-70243-AG-8)
(E73-10095; NASA-CR-130344) Avail: NTIS HC \$3.00 CSCL 04B

N73-18374 Joint Publications Research Service, Arlington, Va. **PHOTOGRAPHING THE EARTH FROM SPACE, PART 2** G. T. Beregovoy, B. V. Vinogradov, G. B. Gonin, O. N. Lebedev, and V. P. Stetsyura / In its Environ. Res. by Means of Manned Space Stations, Pt. 1 24 Jan. 1973 p 68-186 refs

Technical and methodological procedures developed for interpreting space photographs of the earth's surface are discussed. The procedures were developed for the purpose of solving scientific and practical problems relating to natural resource conservation. E.H.W.

N73-18430* Army Engineer Waterways Experiment Station, Vicksburg, Miss.

GROUND TRUTH REQUIREMENTS FOR REMOTE SENSOR DATA ACQUISITION AND ANALYSIS Final Report

Lewis E. Link, Jr. Nov. 1972 49 p refs
(DA Proj. 4A0-62112-A-854)
(AD-752420; AEWES-Misc-Paper-M-72-8) Avail: NTIS CSCL 08/6

Over the past few years airborne remote sensor devices have been developed for different regions of the electromagnetic spectrum that are capable of collecting data on the reflective and emissive properties of terrain. However, experience has shown that the capability to collect data of this type is not, in itself, sufficient to permit its fullest use. In almost every case, data collected with an airborne electromagnetic sensing system (remote sensor) must be augmented by data that define conditions existing in the environment at the time the remote sensor was used. The environmental factors that influence the electromagnetic

energy received by remote sensing devices are defined for the following spectral regions: (a) gamma ray, (b) ultraviolet, (c) visible, (d) infrared, and (e) microwave. In addition, the remote sensing devices used in each spectral region are discussed and the environmental factors appraised for relative importance with respect to the final remote sensing product. Author (GRA)

N73-18437* Franklin Inst., Philadelphia, Pa. Science Information Services Dept.

PHOTOGRAPHY EQUIPMENT AND TECHNIQUES. A SURVEY OF NASA DEVELOPMENTS

Albert J. Derr 1972 188 p refs. Original contains color illustrations

(Contract NASw-1981)

(NASA-SP-5099; LC-72-600108) Avail: NTIS MF \$0.95; SOD HC \$1.50 CSCL 14E

The Apollo program has been the most complex exploration ever attempted by man, requiring extensive research, development, and engineering in most of the sciences before the leap through space could begin. Photography has been used at each step of the way to document the efforts and activities, isolate mistakes, reveal new phenomena, and to record much that cannot be seen by the human eye. At the same time, the capabilities of photography were extended because of the need of meeting space requirements. The results of this work have been applied to community planning and ecology, for example, as well as to space and engineering. Special uses of standard equipment, modifications and new designs, as well as film combinations that indicate actual or potential ecological problems are described. Author

N73-18872* Hughes Aircraft Co., Culver City, Calif.

MECHANICAL COMPONENT SCREENING FOR SCANNER

J. L. Olson and W. J. Quinn / In NASA. Lyndon B. Johnson Space Center The 7th Aerospace Mech. Symp. Nov. 1972 p 59-67

CSCL 20F

N73-19195* Radio Corp. of America, Camden, N.J. Communications Systems Div.

DESIGN STUDY REPORT. VOLUME 2: ELECTRONIC UNIT Feb. 1973 716 p

(Contracts NAS5-11643; NAS5-11288)

(NASA-CR-130187) Avail: NTIS HC \$38.00 CSCL 14C

The recording system discussed is required to record and reproduce wideband data from either of the two primary Earth Resources Technology Satellite sensors: Return Beam Vidicon (RBV) camera or Multi-Spectral Scanner (MSS). The camera input is an analog signal with a bandwidth from dc to 3.5 MHz; this signal is accommodated through FM recording techniques which provide a recorder signal-to-noise ratio in excess of 39 db, black-to-white signal/rms noise, over the specified bandwidth. The MSS provides, as initial output, 26 narrowband channels. These channels are multiplexed prior to transmission, or recording, into a single 15 Megabit/second digital data stream. Within the recorder, the 15 Megabit/second NRZL signal is processed through the same FM electronics as the RBV signal, but the basic FM standards are modified to provide an internal, 10.5 MHz baselband response with signal-to-noise ratio of about 25 db. Following FM demodulation, however, the MSS signal is digitally re-shaped and re-clocked so that good bit stability and signal-to-noise exist at the recorder output. Author

N73-19262* Aerojet ElectroSystems Co., Azusa, Calif.

LWS DESIGN REPLACEMENT STUDY: OPTIMUM DESIGN AND TRADEOFF ANALYSIS Final Report

23 Feb. 1973 64 p

(Contract NAS9-13189)

(NASA-CR-128743; Rept-4713) Avail: NTIS HC \$5.25 CSCL 09C

A design for two long-wavelength (LW) focal-plane and cooler assemblies, including associated preamplifiers and post-amplifiers is presented. The focal-planes and associated electronic assemblies are intended as direct replacement hardware to be installed into

the existing 24-channel multispectral scanner used with the NASA Earth Observations Aircraft Program. An organization skilled in the art of LWIR systems can fabricate and deliver the two long-wavelength focal-plane assemblies described in this report when provided with the data and drawings developed during the performance of this contract. The concepts developed during the study including the alternative approaches and selection of components are discussed. Modifications to the preliminary design as reported in a preliminary design review meeting have also been included. Author

N73-19417# Army Foreign Science and Technology Center, Charlottesville, Va.
INVESTIGATION OF RADIATION PROCESSES IN THE ATMOSPHERE

28 Sep. 1972 131 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 252, 1970 p 3-126 (AD-753975; FSTC-HT-23-129-73) Avail: NTIS CSCL 04/1

The report discusses angular distribution of outgoing shortwave radiation intensity in the event of continuous cloud cover. Construction and operation of a laboratory set-up for measurement of radiation capacity of water in the centimeter range are discussed. The structure and operation of an airborne thermal surveyor and some results of its use for investigation of radiation from underlying surfaces, are discussed. Possibilities of using infrared technology in discovering forest fires from aircraft are discussed. A comparison is made and discussed of measured and calculated values of outgoing longwave radiation for different seasons of the year. Methods and results of calculations of outgoing radiation in the 3-18 micrometer spectral range for certain regions of the Soviet Union are discussed. Author (GRA)

N73-21335# Aerospace Corp., Los Angeles, Calif.
STUDY TO DEMONSTRATE THE FEASIBILITY OF AND DETERMINE THE OPTIMUM METHOD OF REMOTE HAZE MONITORING BY SATELLITE Progress Report, 1 Dec. 1972 - 31 Jan. 1973

Ernest H. Rogers, Principal Investigator 31 Jan. 1973 7 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (Contract NAS5-21719) (E73-10499; NASA-CR-131466) Avail: NTIS HC \$3.00 CSCL 04B

N73-22157# Laboratoire Central de Recherches Thomson-CSF, Orsay (France).

THE CARMIN SYSTEM [CARMIN RAPPORT D'ETUDE] C. Thinet, C. Lemonon, P. Oprandi, and Y. Renard 19 Nov. 1971 65 p In FRENCH (Contract DTAT-SEFT-509/179/50) (LCR-DR-1-71-210/1/R) Avail: NTIS HC \$5.25

Electronic equipment used in a model of the CARMIN system IR television camera for terrain analysis in the 8-13 micrometer band is described. The system has the following properties: image velocity, 16 images per second; spatial resolution, elementary field of 0.5 milliradian; thermal resolution, 0.5 to 25 C. The field of view is from 5 deg 48 min to 3 deg 26 mins. The electronic parts for visualization associated with the optics and the cryogenics of the infrared detector mosaic, and their operation are detailed. The parts include: (1) the linear mosaic of 120 mercury doped germanium detectors with the MOS for impedance adaptation; (2) the elementary amplifiers necessary for stepping up the signal level before switching; (3) the 120 channel MOS switching device for sampling; and (4) the switching sequence generator. ESRO

N73-22274 Colorado Univ., Boulder.
GLOBAL SATELLITE ULTRAVIOLET SPECTROMETER MEASUREMENTS OF NITRIC OXIDE FLUORESCENCE WITH A DIFFUSIVE TRANSPORT MODEL FOR MESOSPHERIC, AND LOWER THERMOSPHERIC NITRIC OXIDE PHOTO-CHEMISTRY Ph.D. Thesis

David William Rusch 1972 148 p
 Avail: Univ. Microfilms Order No. 72-25214

Twilight measurements of fluorescence in the (1,0) gamma band of nitric oxide were made from June 1967 to January 1969 by an ultraviolet scanning spectrometer on board the polar orbiting satellite OGO-4. Nitric oxide vertical column emission rates were measured between solar zenith angles of 93 and 98 degrees. Seasonal and latitudinal variations were found to be less than a factor of 1.5, the scatter and uncertainty in the data prohibiting more precise determinations. Time-independent chemical-diffusion models for the vertical distribution of nitric oxide agree well with profiles measured from sounding rockets. The profiles have a minimum near 85 km of about a million nitric oxide molecules cu cm and a maximum at 105 km of about 10 million nitric oxide molecules cu cm. The column emission rates calculated from the theoretical models are larger than the satellite measurements by a factor of three. Dissert. Abstr.

N73-22338# California Univ., Berkeley. Rocky Mountain Forest and Range Experiment Station.

MULTISTAGE, MULTISEASONAL AND MULTIBAND IMAGERY TO IDENTIFY AND QUALIFY NON-FOREST VEGETATION RESOURCES Remote Sensing Applications in Forestry. Annual Progress Report No. 3

Richard S. Driscoll and Richard E. Francis Calif. Univ. Forestry Remote Sensing Lab. 30 Sep. 1970 71 p refs Prepared for Calif. Univ., Berkeley. Forestry Remote Sensing Lab. (NASA Order R-09-038-002) (NASA-CR-131585; APR-3) Avail: NTIS HC \$5.75 CSCL 02C

A description of space and supporting aircraft photography for the interpretation and analysis of non-forest (shrubby and herbaceous) native vegetation is presented. The research includes the development of a multiple sampling technique to assign

quantitative area values of specific plant community types included within an assigned space photograph map unit. Also, investigations of aerial film type, scale, and season of photography for identification and quantity measures of shrubby and herbaceous vegetation were conducted. Some work was done to develop automated interpretation techniques with film image density measurement devices. Author

N73-22380# Comstock and Wescott, Inc., Cambridge, Mass.
MODIFICATION OF DOUBLE-DECK EUV SPECTROPHOTOMETER Final Report, 1 Sep. 1971 - 31 Aug. 1972

Joseph Padur, P. 16 Oct. 1972 30 p (Contract F19628-72-C-0048; AF Proj. 6688) (AD-756917; AFCRL-72-0738) Avail: NTIS CSCL 04/1

The report describes the refurbishment and modification of a double-deck extreme ultraviolet spectrophotometer recovered from a previous rocket flight. In addition, the report discusses the preparation and launching of two solar extreme ultraviolet spectrophotometers as scientific payloads on sounding rockets. Author (GRA)

N73-22393# Louisiana State Univ., Baton Rouge. Mechanical, Aerospace, and Industrial Engineering Dept.
DESIGN AND CONSTRUCTION OF A REMOTE SENSING APPARATUS Final Report

Dupree Maples and John F. Hagewood [1973] 34 p (Grant NGL-19-001-068) (NASA-CR-124219) Avail: NTIS HC \$3.75 CSCL 14B

The methods of identifying plant and soil types using remote sensing techniques are described. The equipment employed consists of a balloon system and a mobile remote sensing laboratory housing a radiometer which is mounted on a turret mechanism. The radiometer is made up of a telescope whose lenses are replaced by mirrors which channel received radiation into a monochromator. The radiation is then focused onto detectors for measurement of the intensity of the electromagnetic energy as a function of wavelength. Measurements from a wavelength of 0.2 microns to 15 microns are obtained with the system. diagrams are provided. J.M.M.

08 INSTRUMENTATION AND SENSORS

N73-22402# Saab-Scania, Linköping (Sweden).
**STUDY OF PASSIVE MICROWAVE RADIOMETRY AND ITS
 POTENTIAL APPLICATIONS TO EARTH RESOURCES
 SURVEYS**

E. Ohlsson Paris ESRO Sep. 1972 89 p refs
 (Contract ESTEC-1411/71)
 (ESRO-CR-116) Avail: NTIS HC \$6.50

The results of a 9 month study on passive microwave radiometry applied to earth resources surveys are summarized. Activities reported are studies on physical background, material properties, technological implementation, potential applications, and data analysis. An inventory of activities in microwave radiometry in the USA and in Europe was made. The technological studies and identified applications have formed the background for recommendations on a development, evaluation, and application program in Europe. Author (ESRO)

N73-22403# Plessey Co., Ltd., Havant (England).
**MULTISPECTRAL SCANNING SYSTEMS AND THEIR
 POTENTIAL APPLICATION TO EARTH RESOURCE SURVEYS. VOLUME 1: BASIC PHYSICS AND TECHNOLOGY**

A. D. Higham, B. Wilkinson, and D. Kahn Dec. 1972 201 p refs 7 Vol.
 (Contract ESTEC-1673/72-EL)
 (ERL/R-243-U; ESRO-CR(P)-231) Avail: NTIS HC \$12.25

The basic physics of the multispectral sensing process in earth resources surveys are considered, and the sensor techniques necessary to extract useful information are discussed. The sources of radiant energy, effects of the atmosphere, and the radiation/matter interactions, giving rise to useful information, are discussed. The sensing platform, scanning techniques, wavelength selection methods, and detectors are considered, and MSS instruments are described. ESRO

N73-22404# Plessey Co., Ltd., Havant (England). Electronics Research Lab.

**MULTISPECTRAL SCANNING SYSTEMS AND THEIR
 POTENTIAL APPLICATION TO EARTH RESOURCE SURVEYS. VOLUME 2: SPECTRAL PROPERTIES OF MATERIALS**

E. Fitzgerald Dec. 1972 257 p refs 7 Vol.
 (Contract ESTEC-1673/72-EL)
 (ERL/R-244-U; ESRO-CR(P)-232) Avail: NTIS HC \$15.00

The spectral properties in the visible and infrared spectrum of common earth materials such as vegetation, soils, water, minerals, and man-made materials are described. The properties discussed are those of use, or likely to be of use, in the analysis and interpretation of data collected during earth resource surveys from remote platforms. Changes in these properties resulting from variations in the composition and structure of the materials, and variations in the materials' physical environment, are discussed. Author (ESRO)

N73-23463# Lockheed Missiles and Space Co., Palo Alto, Calif.
ANALYTICAL MODEL OF A GEOMAGNETIC SURVEY FROM THE KOSMOS-321

Sh. Sh. Dolginov, N. A. Zhuravleva, A. N. Pushkov, L. O. Tiurmina, and T. N. Cherevko [1973] 2 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 13, no. 1, 1973 p 196-197

Avail: NTIS HC \$3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The mission of the Cosmos-321 satellite is reported. The onboard cesium magnetometer measured the geomagnetic field vector every 2 seconds of flight. A spherical harmonic analysis of the geomagnetic survey was executed by an iteration method. The POGO 8/69 model, reduced to the 1970 epoch, was taken as the zero approximation. Measurements for every 20 seconds of flight, 12,000 points in all, were used to obtain the analytical model of the field. Author

N73-23501# Naval Research Lab., Washington, D.C.
**SKYLAB: SENSORS AND REMOTE SENSING IN SUPPORT
 OF THE EREP OCEANOGRAPHIC PROGRAM Final Report**

Lionel I. Moskowitz 31 Jan. 1973 21 p refs
 (AD-755715; NRL-7543) Avail: NTIS CSCL 08/3

The acquisition of numerous types of oceanographic data over broad areas of the globe from the orbiting of Skylab in mid-1973 heralds a new dimension in oceanography. Remote sensors aboard Skylab will be able to observe ocean-surface phenomena over spatial areas heretofore unobtainable by present techniques. This report describes the applications to oceanography of the various sensor systems aboard Skylab contained in the Earth Resources Experiment Package (EREP). Data from the EREP sensor systems will encompass a broad range of the electromagnetic spectrum. As a consequence, validation of the EREP data will require obtaining correlative data using airborne remote-sensing techniques. For this purpose a C-130 aircraft belonging to the National Oceanic and Atmospheric Administration, equipped with a multitude of environmental sensor systems, will be the primary platform used. The types of surface truth necessary to support the EREP program, as well as a flight program for the C-130, will also be discussed. Author (GRA)

N73-23536# Defense Documentation Center, Alexandria, Va.
COLOR PHOTOGRAPHY Bibliography Report, Mar. 1960 - Aug. 1972

Mar. 1973 171 p refs Revised
 (AD-756700; DDC-TAS-73-10) Avail: NTIS CSCL 14/5

The bibliography contains unclassified and unlimited reports on Color Photography. References range from techniques for producing color pictures from black-and-white negatives to using aerial photography in different spectrum intervals to study vegetation and soils. References included Pseudocolor Enhancement of Biomedical Images; and Photoelectronic Color Separation by Servomechanisms in Cartography. Specialized Photosensitive materials for laser research are also discussed. Author (GRA)

N73-23814*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

ERTS/NIMBUS RADIATION ENVIRONMENT INFORMATION

E. G. Stassinopoulos Apr. 1973 96 p refs
 (NASA-TM-X-66236; X-601-73-122) Avail: NTIS HC \$4.00 CSCL 03B

The results of the ERTS/Nimbus satellite investigation of electron flux levels are presented. Flux calculations were made with the use of two electron environment models, both of which are static and describe the environment during the solar maximum conditions of October 1967. It is concluded that the construction of these models makes it possible to infer a change of the average quiet time electron flux levels as a function of the solar cycle. J.M.M.

N73-24431*# Barringer Research Ltd., Rexdale (Ontario).
**FEASIBILITY STUDY OF THE APPLICATION OF EXISTING
 TECHNIQUES TO REMOTELY MONITOR HYDROCHLORIC
 ACID IN THE ATMOSPHERE**

H. Zwick, V. Ward, and L. Beaudette Apr. 1973 71 p refs
 (Contract NAS1-11923)
 (NASA-CR-112274; TR-73-226A) Avail: NTIS HC \$5.75 CSCL 04A

A critical evaluation of existing optical remote sensors for HCl vapor detection in solid propellant rocket plumes is presented. The P branch of the fundamental vibration-rotation band was selected as the most promising spectral feature to sense. A computation of transmittance for HCl vapor, an estimation of interferent spectra, the application of these spectra to computer modeled remote sensors, and a trade-off study for instrument recommendation are also included. Author

N73-24485*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

**A LINEAR SHIFT-INVARIANT IMAGE PREPROCESSING
 TECHNIQUE FOR MULTISPECTRAL SCANNER SYSTEMS**

C. D. McGillem and T. E. Riemer 1973 57 p refs

(Grant NGL-15-005-112)

(NASA-CR-132957; LARS-022673) Avail: NTIS HC \$5.00 CSCL 14E

A linear shift-invariant image preprocessing technique is examined which requires no specific knowledge of any parameter of the original image and which is sufficiently general to allow the effective radius of the composite imaging system to be arbitrarily shaped and reduced, subject primarily to the noise power constraint. In addition, the size of the point-spread function of the preprocessing filter can be arbitrarily controlled, thus minimizing truncation errors. Author

N73-25384*# Aerospace Corp., Los Angeles, Calif. Space Physics Lab.

STUDY TO DEMONSTRATE THE FEASIBILITY OF AND DETERMINE THE OPTIMUM METHOD OF REMOTE HAZE MONITORING BY SATELLITE Interim Report, Oct. 1972 - Mar. 1973

Ernest H. Rogers, Principal Investigator May 1973 37 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21719)

(E73-10691; NASA-CR-132974) Avail: NTIS HC \$3.00 CSCL 04B

The author has identified the following significant results. Ground truth data has been obtained in order to determine the amount of haze present at the time of ERTS-1 passes over the Los Angeles area. October 21, 1972 was the haziest day, that was essentially cloud free, to date. At the time of the next pass, November 8, 1972 this area was quite clear. Changes in terrain features are minimized because these were consecutive passes. Digital tapes of the ERTS-1 data from these two days are being analyzed to determine the effects of haze on the data, in order to determine the optimum method for monitoring haze from a satellite. Preliminary results indicate that a slight reduction in contrast and some distortion of spectral signatures are caused by heavy haze. This effect is thought to be sufficient to determine the presence of moderate haze without the benefit of ground truth data. It is significant to note that there is very little degradation of ERTS-1 data caused by a rather heavy haze. For many purposes the data obtained on a hazy day are just as useful as that obtained on a clear day.

N73-25387*# Servicio Geologico de Bolivia, La Paz.

EARTH RESOURCES TECHNOLOGY SATELLITE DATA COLLECTION PROJECT ERTS BOLIVIA Progress Report, Oct. 1972 - May 1973

Carlos E. Brockman, Principal Investigator May 1973 5 p Sponsored by NASA ERTS

(E73-10695; NASA-CR-132999) Avail: NTIS HC \$3.00 CSCL 05B

N73-25413*# South Alabama Univ., Mobile. Dept. of Mechanical Engineering.

ATMOSPHERIC EFFECTS ON REMOTE SENSING OF NON-UNIFORM TEMPERATURE SOURCES

W. A. McNeill, J. M. Elliott, and B. P. Dixon 22 May 1973 38 p refs

(Contract NAS8-28722)

(NASA-CR-129004) Avail: NTIS HC \$4.00 CSCL 04A

The equations of transfer, for a plane-parallel scattering atmosphere with a point source of energy on the lower bounding surface, were solved for various values of sensor/point source orientation and optical depths. Applications of this analysis to Skylab and ERTS mission are discussed, and requirements for atmospheric property data and radiation transfer properties are considered. Author

N73-25485 Pennsylvania Univ., Philadelphia.

REMOTE SENSING AND RF INTERFEROMETRY Ph.D. Thesis

Richard Kenneth Thomas 1972 117 p

Avail: Univ. Microfilms Order No. 73-1459

The determination of the sea height power spectrum by RF interferometric techniques using a bistatic scattering system is discussed. The scattering process produces an angular spectrum of plane waves which is filtered not only by the beamwidth of the interferometer antennas but also by the real angle limitation beyond which the waves are evanescent. The interferometer, with appropriate signal processing, yields a coherence function which is shown to be the Fourier transform of a quantity related to the sea height power spectrum. It is concluded that RF interferometry offers a valid means of determining structural properties of the sea, analogous to the radio astronomy application for measuring brightness distribution. Dissert. Abstr.

N73-25474*# Hughes Aircraft Co., El Segundo, Calif.

MULTISPECTRAL SCANNER SYSTEM FOR ERTS: FOUR-BAND SCANNER SYSTEM. VOLUME 1: SYSTEM DESCRIPTION AND PERFORMANCE

V. T. Norwood, L. R. Fermelia, and G. A. Tadler Aug. 1972 133 p

(Contract NAS5-11255)

(NASA-CR-132758; HS-324-5214) Avail: NTIS HC \$8.75 CSCL 14B

The four-band Multispectral Scanner System (MSS) is discussed. Included is a description of the MSS with major emphasis on the flight subsystem (scanner and multiplexer), the theory for the MSS calibration system processing techniques, system calibration data, and a summary of the performance of the two four-band MSS systems. Author

N73-25491# Environmental Research Inst. of Michigan, Ann Arbor.

TECHNIQUES FOR MEASURING LIGHT ABSORPTION, SCATTERING, AND PARTICLE CONCENTRATIONS IN WATER Final Report, May 1971 - Feb. 1973

O. E. Prewett, D. R. Lyzenga, F. C. Polcyn, and W. L. Brown Apr. 1973 39 p refs

(Contract N62306-71-C-1823)

(AD-759668; ERIM-190500-1-F) Avail: NTIS CSCL 14/2

The purpose of the research reported was to investigate the usefulness of multispectral remote sensing techniques in determining the concentration of suspended solids in aquatic environments. For the research, aerial photography and multispectral scanner imagery was used to record the upwelling radiation at various locations on the surface of the water. Procedures for determining the concentration of suspended solids are explored. Two techniques are discussed: The first applies to bodies of water that are shallow and fairly clear; The second applies to bodies of water that are deep or very turbid. The first technique is a direct outgrowth of earlier water-depth studies and, when the necessary ground-truth data are available, can also be used to determine water depth or the scattering and adsorption coefficients of the lake. The second has the advantage of requiring less ground truth data for interpretation of the remote measurements. Both techniques are feasible within certain operational constraints. Both give values of the concentration of suspended solids, relative to the concentration at a fixed point, for every location in a body of water for which multispectral data are available. GRA

N73-25678*# Alabama Univ., Huntsville. School of Graduate Studies and Research.

REMOTE ANALYSIS OF PLANETARY SOILS: X-RAY DIFFRACTOMETER DEVELOPMENT Final Report

John C. Gregory Apr. 1973 40 p refs

(Contract NAS8-27336)

(NASA-CR-124271) Avail: NTIS HC \$4.00 CSCL 03B

A system is described suitable for remote low power mineralogical analysis of lunar, planetary, or asteroid soils. It includes an X-ray diffractometer, fluorescence spectrometer, and sample preparation system. A one Curie Fe-55 source provides a monochromatic X-ray beam of 5.9 keV. Seeman-Bohlin or focusing geometry is employed in the camera, allowing peak detection to proceed simultaneously at all angles and obviating the need for moving parts. The detector system is an array of 500-800 proportional counters with a wire-spacing of 1 mm. An electronics unit comprising preamplifier, postamplifier, window

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discriminators, and storage flipflops requiring only 3.5 milliwatts was designed and tested. Total instrument power is less than 5 watts. Powder diffraction patterns using a flat breadboard multiwire counter were recorded. Author

N73-26328* Arizona Univ., Tucson.
EVALUATION OF ERTS-1 IMAGE SENSOR SPATIAL RESOLUTION IN PHOTOGRAPHIC FORM Progress Report P. N. Slater, Principal Investigator, R. L. Antos, and R. A. Showengerdt Jul. 1973 13 p ERTS (Contract NAS5-21849) (E73-10721; NASA-CR-133221; PR-5) Avail: NTIS HC \$3.00 CSCL 14E

N73-26380* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
[SKYLAB PRELAUNCH PLANS] Monthly Report, Apr. 1973 LaRoy F. Silva, Principal Investigator 21 Jun. 1973 2 p EREP (Contract NAS9-13301) (E73-10760; NASA-CR-133128) Avail: NTIS HC \$3.00 CSCL 05B

N73-27108* Joint Publications Research Service, Arlington, Va.
RADARS WITH SYNTHESIZED ANTENNA N. I. Burenin 29 Jun. 1973 149 p refs Transl. into ENGLISH of the book "Radiolokatsionnyye Stantsii s Sintezirovannyi Antennoy" Moscow, Sov. Radio, 1972 160 p (JPRS-59391) Avail: NTIS HC \$9.50

The theory of coherent side-looking radar designed to obtain a detailed radar image of the earth's surface from aircraft and spacecraft is presented. Author

N73-27123* Illinois Univ., Urbana. Dept. of Civil Engineering.
GEOMETRIC ANALYSIS OF THE RBV TELEVISION SYSTEM, PHASE 2 Final Report, 16 Jun. 1971 - 15 Sep. 1972 Kam W. Wong 15 Sep. 1972 76 p refs (Contract DI-14-08-0001-12631) (PB-218393/7; UULU-ENG-72-2016; USGS-DO-73-006; Ser-35) Avail: NTIS HC \$3.00 CSCL 17B

The geometric distortion characteristics and calibration problems of the return-beam vidicon (RBV) television systems being used in the Earth Resources Technology Satellites (ERTS) program was discussed. The overall objectives of this project are: (1) to establish the magnitude, pattern, and stability of geometric distortions in the RBV systems; (2) to devise procedures and data reduction methods for the accurate calibration of the system internal geometry; and (3) to provide accurate distortion and calibration data for detailed analysis of the potential mapping accuracy of the RBV images. GRA

N73-27239* Ohio Dept. of Economic and Community Development, Columbus.
[COLLECTION OF OHIO GROUND TRUTH DATA FOR SKYLAB EREP] Quarterly Progress Report, Apr. - Jun. 1973 David C. Sweet, Principal Investigator Jun. 1973 2 p EREP (NASA Order C-21372-C) (E73-10757; NASA-CR-133125) Avail: NTIS HC \$3.00 CSCL 05B

N73-27240* Kansas Univ. Center for Research, Inc., Lawrence.
INFLUENCE OF ATMOSPHERE PATHLENGTHS FOR DIFFERENT BANDS Robert M. Haralick, Principal Investigator and K. Sam Shaumtugan 9 Jan. 1973 2 p ERTS (Contract NAS5-21822) (E73-10763; NASA-CR-132205) Avail: NTIS HC \$3.00 CSCL 04A

The author has identified the following significant results. Comparison of ERTS-1 imagery in three bands (MSS-4, 5, and 7) acquired over southwestern Kansas on 1 Dec. 72 reveals that low solar altitude has a pronounced different effect on apparent scene illumination in different bands.

N73-27273* Argus Exploration Co., Los Angeles, Calif.
[ACQUISITION OF WEATHER AND GROUND DATA FOR SKYLAB] Monthly Progress Report, 11-30 Apr. 1973 Ira C. Bechtold, Principal Investigator 30 Apr. 1973 2 p EREP (Contract NAS9-13269) (E73-10797; NASA-CR-133203) Avail: NTIS HC \$3.00 CSCL 05B

N73-27278* Geological Survey, Miami, Fla.
ADVANTAGES OF ERTS DATA COLLECTION SYSTEM IN SOUTH FLORIDA Progress Report, 1 Apr. - 1 Jun. 1973 A. L. Higer, Principal Investigator, E. T. Wimberly, E. H. Cordes, and A. E. Coker 1 Jun. 1973 5 p ERTS (NASA Order S-70243-AG-7) (E73-10803; NASA-CR-133287) Avail: NTIS HC \$3.00 CSCL 05B

N73-27283* Stanford Univ., Calif. School of Earth Sciences.
MULTISPECTRAL SIGNATURES IN RELATION TO GROUND CONTROL SIGNATURES USING NESTED SAMPLING APPROACH Progress Report, 2 May - 2 Jul. 1973 R. J. P. Lyon and A. A. Green, Principal Investigators 3 Jul. 1973 20 p ERTS (Contract NAS5-21884) (E73-10808; NASA-CR-133292; PR-4) Avail: NTIS HC \$3.00 CSCL 05B

The author has identified the following significant results. An experiment was conducted to evaluate the feasibility of using ERTS-1 MSS imagery for spot transmission measurements on selected sites. Using the 15-unit gray scale on the 70 mm positive imagery as the base of comparison, a correlation was made between the transmittance measured at each site on the imagery and the radiance values (counts) recorded on CCT tape by the spacecraft over the same sites. The imagery was enlarged by a 750-watt projector and focused on a white cardboard screen 6 meters from the screen. Observations were made on 30 sub-sites which were pre-selected for their differing image brightness and total area; all are dried pond beds. Observations were also made on average gray backgrounds and a small lake. There was a very good correlation between the density values obtained from projected imagery and radiance values received by the detector on the spacecraft. A shorter experiment time and closer integration of gray scale and site readings would avoid the variation in lamp intensities that occurred.

N73-27284* Stanford Univ., Calif. School of Earth Sciences.
MULTISPECTRAL SIGNATURES IN RELATION TO GROUND CONTROL SIGNATURES USING NESTED SAMPLING APPROACH Progress Report, 3 Jan. - 2 Mar. 1973 R. J. P. Lyon and A. A. Green, Principal Investigators 3 Mar. 1973 9 p ERTS (Contract NAS5-21884) (E73-10809; NASA-CR-133293; PR-2) Avail: NTIS HC \$3.00 CSCL 05B

N73-27285* Stanford Univ., Calif. School of Earth Sciences.
MULTISPECTRAL SIGNATURES IN RELATION TO GROUND CONTROL SIGNATURES USING NESTED SAMPLING APPROACH Progress Report, 3 Nov. 1972 - 2 Jan. 1973 R. J. P. Lyon and A. A. Green, Principal Investigators 3 Jan. 1973 5 p ERTS (Contract NAS5-21884) (E73-10810; NASA-CR-133294; PR-1) Avail: NTIS HC \$3.00 CSCL 05B

N73-27315* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

NIMBUS 4 IRIS SPECTRA IN THE 750-1250/cm ATMOSPHERIC WINDOW REGION

V. G. Kunde, B. J. Conrath, R. A. Hanel, and C. Prabhakara
May 1973 15 p refs Submitted for Publication
(NASA-TM-X-66281; X-622-73-191) Avail: NTIS HC \$3.00
CSCL 04A

Several Nimbus 4 IRIS spectra are presented for the 700-1300/cm region as examples of free atmosphere spectra to illustrate problems encountered in interpreting window measurements. Several atmospheric windows near 936 and 960/cm appear significantly more transparent than the 899/cm window presently used in operational remote sensing systems.

Author

N73-27317* Techtran Corp., Glen Burnie, Md.

RESULTS OF REMOTE SOUNDING OF THE ATMOSPHERE AND OCEAN IN THE INFRARED AND MICROWAVE REGIONS ON THE 13TH VOYAGE OF THE SCIENTIFIC RESEARCH VESSEL "ACADEMICIAN KURCHATOV"

A. K. Gorodetskiy, D. T. Matveyev, and A. P. Orlov Washington
NASA Jul. 1973 22 p refs Transl. into ENGLISH of "Rezultaty Distantionnogo Zondirovaniya Atmosfery i Okeana v Infrazasnom i Mikrovolnovom Diapazonakh v XIII Reyse Nis "Akademik Kurchatov", Acad. of Sci., Inst. of Space Res., Moscow, report presented at Meeting of the Sov.-Am. Working Group on Remote Sensing of Natural Environment from Space, 12-17 Feb. 1973 47 p

(Contract NASw-2485)

(NASA-TT-F-14972) Avail: NTIS HC \$3.25 CSCL 04A

Thermal emission from the sea surface and atmosphere were studied in the infrared and microwave regions by semiautomatic cameras and photometer aboard ship in the North Atlantic. The role of sea foam in affecting microwave emission was also examined.

Author

N73-27831* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

MULTISPECTRAL SCANNER (MSS), ERTS-1

Joseph Arlauskas In its Significant Accomplishments in Technol., 1972 1973 p 60-62
CSCL 14B

N73-27832* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

TWO-INCH RETURN BEAM VIDICON (RBV) MULTISPECTRAL THREE CAMERA SUBSYSTEM

Oscar Weinstein In its Significant Accomplishments in Technol., 1972 1973 p 63-66
CSCL 14E

N73-27833* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ERTS WIDEBAND TAPE RECORDER

John M. Hayes In its Significant Accomplishments in Technol., 1972 1973 p 67-70
CSCL 14C

N73-27834* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

VISIBLE INFRARED SPIN-SCAN RADIOMETER

James E. Phenix In its Significant Accomplishments in Technol., 1972 1973 p 71-73
CSCL 14B

N73-28279* Japan Meteorological Agency, Tokyo.

APPLICATION OF ERTS DATA TO THE DETECTION OF THIN CIRRUS AND CLEAR AIR TURBULENCE

Kiyoshi Tsuchiya and Toshiro Kamiko (Tokyo Intern. Air Weather Service) In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 673-680 refs Original contains imagery.

Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-E14B) CSCL 04B

The feasibility of detecting a thin cirrus and clear air turbulence from ERTS MSS data is explored. The result of analyses indicates that a thin cirrus not shown in conventional meteorological satellite picture can be revealed in ERTS MSS picture. It is also found that the core of jet stream can be located with high accuracy from ERTS pictures and the possible area of clear air turbulence can be predicted if the data of the quality of ERTS data are available in real time.

Author

N73-28324* Science Applications, Inc., La Jolla, Calif.

DETERMINATION OF AEROSOL CONTENT IN THE ATMOSPHERE

Michael Griggs In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1105-1113 refs ERTS

(Paper-12) CSCL 04B

This investigation is designed to demonstrate the feasibility of determining the aerosol content in the atmosphere from contrast measurements of ground features, and from radiance measurements. Theoretical relationships between aerosol content and contrast reduction and radiance have been derived for ideal model atmospheres. The preliminary data analysis of the MSS transparencies has shown promising results for the contrast-aerosol content relationship in the Salton Sea/desert region.

Author

N73-28326* International Imaging Systems, Mountain View, Calif.

EXPERIMENTAL MASKING OF RBV IMAGES TO REDUCE STATIONARY RESIDUAL INACCURACIES IN RADIOMETRIC CORRECTION

Donald S. Ross In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1123-1128 ref Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls S. D. 57198 ERTS

(Paper-14) CSCL 05B

Return beam vidicon tube calibration data are used to correct spatially non-uniform radiance response in individual vidicons, during post-acquisition signal processing. However, examination of different ERTS-1 RBV-1, -2, and -3 image scenes showed stationary, repetitive residual inaccuracies in shading, correction, large enough to affect qualitative and quantitative image analyses. Photographic masks designed to reduce residual shading were prepared from RBV-1, -2, and -3 images of a relatively cloud-free ocean scene of uniform reflectance. When applied to other RBV scenes, the masks enabled more closely corrected RBV images to be printed. Illustrations are given of RBV-1 image before and after correction, compared with an equivalent MSS spectral image of the same scene.

Author

N73-28371* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

COMPUTED ATMOSPHERIC EFFECTS ON ERTS OBSERVATIONS

Robert S. Fraser In its Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1567-1573 refs ERTS
CSCL 05B

The nadir radiances of many models of the earth atmosphere system were computed for a fixed solar zenith angle. These data indicate that the standard deviations of the multispectral scanner responses to changes in water vapor and aerosols would be small on a continental-wide basis.

Author

N73-28434* Environmental Research and Technology, Inc., Lexington, Mass.

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EXPERIMENTAL EVALUATION OF ATMOSPHERIC EFFECTS ON RADIOMETRIC MEASUREMENT USING THE EREP OF SKYLAB Quarterly Progress Report

David T. Chang, Principal Investigator 7 Aug. 1973 2 p EREP

(Contract NAS9-13343)

(E73-10857; NASA-CR-133445; QPR-1) Avail: NTIS HC \$3.00 CSCL 03B

N73-28450# Plessey Co., Ltd., Havant (England).

MULTISPECTRAL SCANNING SYSTEMS AND THEIR POTENTIAL APPLICATION TO EARTH RESOURCE SURVEYS. VOLUME 4: EARTH SCIENCE APPLICATIONS

Apr. 1973 209 p refs

(Contract ESTEC-1673/72-EL)

(ERL/R-246; ESRO-CR(P)-234) Avail: NTIS HC \$12.50

Research studies in agriculture, geography, geology, hydrology, and oceanography are presented, using multispectral scanning systems (MSS). Recommendations are given for European programs.

N73-28451 Reading Univ. (England).

AN APPROACH TO THE EVALUATION OF MULTISPECTRAL SCANNING SYSTEMS

R. A. G. Savigear /in Plessey Radar Res. Centre Multispectral Scanning Systems and their Potential Appl. to Earth Resource Surveys Apr. 1973 p 7-50 refs

The data gathering potential of multispectral scanning (MSS) and the basic approach to the utilization of MSS data are discussed. The interdisciplinary aspects of MSS are considered, and its application to the fields of geology, hydrology, soil science, geomorphological analysis, and landscape mapping is described. An illustration of the necessity for regional integrated approaches is given using urban, mountain, desert, and oceanic environments as examples. ESRO

N73-28458# Stockholm Univ. (Sweden). Dept. of Physical Geography.

THE APPLICATION OF PASSIVE MICROWAVE RADIOMETRY TO EARTH-RESOURCE SURVEYS

G. Hoppe, M. Falkenmark (Intern. Hydrol. Decade, Swed.), U. Karstroem (Meteorol. and Hydrol. Inst., Swed.), H. Svensson (Lund Univ.), and D. S. Parasnis (Uppsala Univ.) Paris ESRO Jun. 1972 108 p refs Prepared for SAAB-Scania AB, Linköping, Swed.

(Contract ESTEC-1411/71)

(ESRO-CR-75) HC \$7.50

Passive microwave radiometry applied to the earth's surface is a discipline of remote sensing that makes use of the thermal energy emitted by objects at microwave wavelengths. Applications of microwave radiometry to the fields of agriculture (soils, vegetation, forests), geography (physical and human), hydrology, oceanography, and geology, are considered. It was concluded that microwave radiometry has great potential value in the fields of application studied and that substantial efforts in the investigation of various applications and in the development of the relevant technological methods is justified. It is recommended that high priority be given to compiling an inventory of earth resources and to monitoring environmental changes. It was also recommended that a development programme be undertaken to improve the performance of radiometric sensors available in Europe, that microwave radiometry be tested in comparison with other remote sensing techniques over selected sites with the aid of aircraft as a preparation for similar work with satellites, and that international cooperation be sought in this work since the problems encountered will undoubtedly be common to many geographical areas. Author

N73-29231*# National Environmental Satellite Service, Washington, D.C.

A CLOUD PHYSICS INVESTIGATION UTILIZING SKYLAB DATA Quarterly Progress Report

John Allhouse, Herbert Jacobowitz, and David Wark, Principal

Investigators 29 Jun. 1973 6 p EREP

(NASA Order T-4715-B)

(E73-10880; NASA-CR-133497; QPR-1) Avail: NTIS HC \$3.00 CSCL 04B

N73-29245*# Kansas Univ. Center for Research, Inc., Lawrence, Space Technology Labs.

[PREPARATION OF CATALOGS AND EQUIPMENT FOR SKYLAB EXPERIMENTS] Monthly Progress Report, 15 May - 30 Jun. 1973

R. K. Moore, Principal Investigator and Arun Sobti 24 Aug. 1973 3 p EREP

(Contract NAS9-13331)

(E73-10896; NASA-CR-133553) Avail: NTIS HC \$3.00 CSCL 05B

N73-29246*# Kansas Univ. Center for Research, Inc., Lawrence, Space Technology Labs.

[PREPARATION OF CATALOGS AND EQUIPMENT FOR SKYLAB EXPERIMENTS] Progress Report, 1-31 Jul. 1973

R. K. Moore, Principal Investigator and Arun Sobti 24 Aug. 1973 2 p EREP

(Contract NAS9-13331)

(E73-10897; NASA-CR-133554) Avail: NTIS HC \$3.00 CSCL 05B

N73-29266*# Research Triangle Inst., Durham, N.C.

[ACQUISITION OF QUICK-LOOK DATA FROM SL-2] Monthly Progress Report, 1-31 Jul. 1973

Lee S. Miller and Gary S. Brown, Principal Investigators 14 Aug. 1973 2 p EREP

(Contract NAS9-13304)

(E73-10917; NASA-CR-133574) Avail: NTIS HC \$3.00 CSCL 05B

N73-29273*# Aerospace Corp., Los Angeles, Calif.

STUDY TO DEMONSTRATE THE FEASIBILITY OF AND DETERMINE THE OPTIMUM METHOD OF REMOTE HAZE MONITORING BY SATELLITE Progress Report, 1 Apr. - 31 May 1973

Ernest H. Rogers, Principal Investigator 31 May 1973 15 p ERTS

(Contract NAS5-21719)

(E73-10924; NASA-CR-133581) Avail: NTIS HC \$3.00 CSCL 04B

N73-29280# Israel Program for Scientific Translations, Ltd., Jerusalem.

ACTINOMETRY AND ATMOSPHERIC OPTICS

V. K. Pyldmas, ed. 1971 390 p refs Transl. into ENGLISH from the book "Aktinometriya i Atmosferaya Optika" Izdatel'stvo Valgus, Tallin, 1968 390 p Proc. of the 6th Interdepartmental Symp. on Actinometry and Atmospheric Optics, Tartu, USSR, Jun. 1966 Prepared for NSF, and NOAA

(TT-70-50159) Avail: NTIS HC \$21.50

The proceedings of a conference on actinometry and atmospheric optics are presented. The subjects discussed are: (1) radiation regime of the atmosphere, (2) atmospheric radiation and weather, (3) actinometric instruments, and (4) atmospheric radiation and plants. Emphasis is placed on the characteristics of photosynthesis for various types of plants with respect to light conditions in the atmosphere.

N73-29879# National Environmental Satellite Service, Washington, D.C.

ENVIRONMENTAL SATELLITE IMAGERY, JANUARY 1973 Environ. Data Serv. Jul. 1973 98 p refs

Avail: NTIS HC \$7.00

Photographic imagery obtained by the NOAA 2 satellite during the period of 1 January to 30 January, 1973 is discussed. The satellite-borne photographs of the Northern and Southern Hemispheres are presented for each day under day and night conditions. The operation of the scanning radiometer and the functions of the command and Data Acquisition stations are reported. Author

N73-29880# National Environmental Satellite Service, Washington, D.C.

ENVIRONMENTAL SATELLITE IMAGERY, JUNE 1973

Environ. Data Serv. Jul. 1973 95 p refs

Avail: NTIS HC \$6.75

Photographic imagery obtained by the NOAA 2 satellite during the period of 1 June to 30 June 1973 is discussed. The satellite-borne photographs of the Northern and Southern Hemispheres are presented for each day under day and night conditions. The operation of the scanning radiometer and the functions of the Command and Data Acquisition stations are reported. Author

N73-30275*# Stanford Univ., Calif. School of Earth Sciences. **MULTISPECTRAL SIGNATURES IN RELATION TO GROUND CONTROL SIGNATURES USING NESTED-SAMPLING APPROACH** Progress Report, 3 Jul. - 2 Sep. 1973

R. J. P. Lyon and A. A. Green, Principal Investigators 3 Sep. 1973 12 p ERTS

(Contract NAS5-21884)

(E73-10933; NASA-CR-133804; PR-5) Avail: NTIS HC \$3.00 CSCL 05B

N73-30285*# Agricultural Research Service, Weslaco, Tex. **[SL-2 MULTISPECTRAL BAND CAMERA PHOTOGRAPHY]** Progress Report, Aug. 1973

Craig L. Wiegand, Principal Investigator 7 Sep. 1973 2 p EREP

(NASA Order T-4105-B)

(E73-10943; NASA-CR-133619; PR-3) Avail: NTIS HC \$3.00 CSCL 14E

N73-30287*# South Dakota State Univ., Brookings. Remote Sensing Inst.

[SITE SELECTION AND DATA ACQUISITION FOR SL-3 MISSION] Monthly Progress Report, period ending 1 Sep. 1973

Victor I. Myers, Principal Investigator 1 Sep. 1973 3 p EREP

(Contract NAS9-13337)

(E73-10945; NASA-CR-133621) Avail: NTIS HC \$3.00 CSCL 14B

N73-30288*# Agricultural Research Service, Weslaco, Tex. **REFLECTANCE OF VEGETATION, SOIL, AND WATER** Progress Report, 19 Jun. - 19 Aug. 1973

Craig L. Wiegand, Principal Investigator 19 Aug. 1973 6 p ERTS

(NASA Order S-70251-AG)

(E73-10946; NASA-CR-133622; PR-4) Avail: NTIS HC \$3.00 CSCL 08M

The author has identified the following significant results. A ratio of MSS channels 5 and 7 (5/7) and 5 to 6 (5/6) signals resulted in a correct recognition of 86.9% of the members of representative crop and soil conditions, compared with recognitions of 60.0, 64.1, 74.1, and 81.4% for channels 4, 5, 6, and 7 taken individually. Based on this result a satellite channel ratio procedure has been developed that enhances line printer gray maps for more efficient experimental test site location in the CCT data. Because independent estimates are not available to judge acreage estimates derived from ERTS-1 data against, except for a few crops, an interpenetrating sample constituting 3.5% of the county is ground truthed periodically. The crop of land uses and their acreages, respectively, as estimated from the interpenetrating samples, are: cotton, 129,714; sorghum, 182,783; mixed citrus, 53,954; oranges, 16,929; grapefruit, 13,863; rangeland, 137,845; and improved pastures, 57,169.

N73-30327 Joint Publications Research Service, Arlington, Va. **OPTIMAL SELECTION OF THE SPECTRAL INTERVALS OF REMOTE INDICATION OF THE NATURAL ENVIRONMENT FROM SPACE**

K. Ya. Kondratyev, O. B. Vasilyev, and G. A. Ivanyan *In its Meeting of the Sov.-Am. Working Group on Remote Sensing of*

the Nat. Environment from Space (JPRS-59739) 8 Aug. 1973 p 120-141 refs Transl. into ENGLISH from the publ. "Vstrecha Sovetsko-Amerikanskoy Rabochey Gruppy po Issledovaniyu Okruzhayushchey Sredy iz Kosmosa" Moscow, Acad. of Sci. USSR, 1973 30 p

The problem of determining the optimal set of spectral intervals having maximum informativeness with minimum number of intervals is dealt with. The problem is solved on the basis of an objective (quantitative) analysis of the informativeness of the optical characteristics of the natural formation on various wavelengths. Using this method, spectral intervals were obtained which are proposed as being the most informative for surveying the earth's surface from a spacecraft. The obtained optimal intervals are compared with those used with the ERTS-1 and it is concluded that the ERTS-1 intervals cannot be considered optimal. D.L.G.

N73-30347*# Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.

MULTISPECTRAL SCANNER DATA PROCESSING ALGORITHM DOCUMENTATION Technical Report, 1 Nov. 1971 - 31 Jan. 1973

M. Gordon and J. Erickson Jul. 1973 80 p Original contains color illustrations

(Contract NAS9-9784)

(NASA-CR-134007; ERIM-31650-149-T) Avail: NTIS HC \$6.00 CSCL 05B

The algorithms employed in the current ERIM data processing scheme are described. Methods for suitable visual display of the results of this processing are discussed. Author

N73-30373# Oklahoma State Univ., Stillwater. **REMOTE SENSING RESEARCH PROJECT. GLOSSARY OF AERIAL PHOTOGRAPHY AND REMOTE SENSING IN GEOLOGY AND EARTH SCIENCES**

Mohamed Abdel-Hady and Hassan Mostafa Dec. 1972 92 p refs

(Grant NSF GF-31866)

(PB-220154/9; IR-3) Avail: NTIS HC \$3.00

The glossary includes definitions of 470 terms which are of common use by the photogeologists and the interpreters of remote sensing and aerial photography in their fields of applications in geology and earth sciences. It was compiled to have a standard set of definitions for the technical terms commonly used in aerial photography. Arranged alphabetically, it is the third interim report on the research project "Remote Sensing Techniques in the Arab Republic", and compliments the previous reports with its explanations. (Modified author abstract) (GRA)

N73-31313*# General Electric Co., Beltsville, Md.

DATA COLLECTION PLATFORM/FIELD TEST SET PROGRAM Final Report, Jul. 1971 - Oct. 1972

G. C. VanNostrand, Principal Investigator and G. Meyerson 23 Apr. 1973 42 p refs ERTS

(Contract NAS5-21697)

(E73-11008; NASA-CR-133801; Doc-73SD4233) Avail: NTIS HC \$4.25 CSCL 14B

N73-31314*# Boeing Co., Seattle, Wash.

QUANTITATIVE DETERMINATION OF STRATOSPHERIC AEROSOL CHARACTERISTICS Monthly Report, Aug. 1973

David L. Tingey, Principal Investigator Aug. 1973 1 p EREP

(Contract NAS9-13303)

(E73-11009; NASA-CR-133802) Avail: NTIS HC \$3.00 CSCL 04A

N73-31317*# Michigan State Univ., East Lansing.

[GROUND TRUTH ACQUISITION] Progress Report, Aug. 1973

Lester V. Manderscheid, Principal Investigator 19 Sep. 1973 1 p EREP

(Contract NAS9-13332)

(E73-11012; NASA-CR-133805) Avail: NTIS HC \$3.00 CSCL 08B

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N73-31333* Aerospace Corp., Los Angeles, Calif.
STUDY TO DEMONSTRATE THE FEASIBILITY OF AND DETERMINE THE OPTIMUM METHOD OF REMOTE HAZE MONITORING BY SATELLITE Progress Report, 1 Jun. - 31 Jul. 1973

Ernest H. Rogers, Principal Investigator. 31 Jul. 1973 2 p ERTS

(Contract NAS5-21719)

(E73-11029; NASA-CR-133861) Avail: NTIS HC \$3.00 CSCL 04B

N73-31365* Smithsonian Astrophysical Observatory, Cambridge, Mass.

THE APPLICATION OF VLB INTERFEROMETRY TO EARTH MEASUREMENTS Final Report

Richard D. Michelini Apr. 1973 84 p refs

(Contract NSR-09-015-079)

(NASA-CR-135493) Avail: NTIS HC \$6.25 CSCL 08E

Results of a four-phase development of capability in very long-baseline interferometry (VLBI) at the Smithsonian Astrophysical Observatory (SAO) are summarized. The objectives of the VLBI program at SAO are to: (1) develop the capability to collect, process, and analyze VLBI data; (2) determine experimentally the accuracy now attainable with VLBI and, within the constraints imposed by this accuracy, initiate a program of VLBI observations for geophysical applications; (3) identify all significant error sources and devise means for eliminating or correcting these errors; and (4) develop a long range plan for applying VLBI techniques to a program of earth physics measurements. Author

N73-31375* Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.

A GEOMETRIC INVESTIGATION OF THE EFFECT OF VIEWING ANGLE ON THE GROUND RESOLUTION OF SATELLITE-BORNE SENSORS

Louis D. Duncan Ft. Monmouth, N. J. ECOM Jul. 1973 20 p refs

(DA Proj. 1T0-61102-B-53A)

(AD-764246; ECOM-5502) Avail: NTIS CSCL 08/2

A system of equations has been developed to determine the area (ground resolution) on the surface of the earth observed by a satellite-borne sensor. These equations were used to investigate the relative change in ground resolution for a sensor viewing at other than the subsatellite point. Computations were performed for various values of satellite altitude, viewing angle, and field of view of the sensor. Selected results are presented in graphic and tabular form. Results indicate that, for a fixed satellite altitude, the relative change in ground resolution is a function primarily of the viewing geometry, with only minor dependence upon the size of the field of view. Author (GRA)

N73-31376* Army Engineer Topographic Labs., Fort Belvoir, Va.

ON THE THERMAL NATURE AND SENSING OF SNOW-COVERED ARCTIC TERRAIN

Ambrose O. Poulin May 1973 189 p refs

(DA Proj. 4A0-61102-B-520)

(AD-764239; ETL-RN-73-4) Avail: NTIS CSCL 08/6

Thermal infrared imagery (8 to 14 micrometers) of selected areas of the North American Arctic above the 75th parallel was obtained at three different periods: early winter, midwinter and early spring. Data runs totaling approximately 2500 nautical miles in length were made at altitudes ranging from 1000 to 20,000 feet. Environmental conditions included: (1) daytime with solar altitudes from 2 to 27 degrees and the atmosphere ranging from very clear to very hazy, and (2) very clear to very hazy conditions during the dark season. Subjects covered included sea ice, coastal areas, inland areas, lakes, streams, glaciers, the Greenland Ice Cap, and the Ward-Hunt Ice Shelf. Questions arising from analysis of the imagery led to a winter experiment in which study was concentrated on the temperature differences that develop at shorelines, but a number of secondary studies were also conducted. Aerial radiometric data and photographs were correlated with ground data which included subsurface temperatures in the soil, ice, and snow on both sides of a shoreline. A

classification system for thermal features exhibited by arctic terrain and preliminary criteria for seasonal maps was developed. (Modified author abstract) GRA

N73-31394 Kansas Univ., Lawrence.

ANALYSIS OF S193 MICROWAVE RADIOMETER SCATTEROMETER FOR SKYLAB Ph.D. Thesis

Walter Robert Hanley 1972 538 p

Avail: Univ. Microfilms Order No. 73-11890

A detailed evaluation and suggested modification are provided here for the radiometer-scatterometer system (designated S193) which is to be flown on Skylab A. The S193 combines a radiometer, scatterometer, and altimeter into an integrated system. The system is proposed as part of the instrumentation package required for the execution of Earth Resources Experiments on-board the Skylab A space vehicle. The capabilities and limitations on the configuration being implemented are assessed. Several recommendations have been made for configuration changes, and some of them have been incorporated into the system design. Others, due to hardware commitments, development requirements, cost or program schedule, have not been incorporated in the present design for S193; however, they should be considered in future designs. Dissert. Abstr.

N73-31417* Brookhaven National Lab., Upton, N.Y.

EVALUATION OF AN AIRBORNE GAS CHROMATOGRAPH FOR LONG DISTANCE METEOROLOGICAL TRACING

R. N. Dietz, E. A. Cote, and G. J. Ferber (NOAA, Silver Spring, Md.) 1972 7 p refs Presented at 165th Meeting of the Am. Chem. Soc., Dallas, Tex., 8 Apr. 1973

(BNL-17478; Conf-730403-2) Avail: NTIS HC \$3.00

The capability of the portable SF6 chromatograph to detect and quantitatively determine the behavior of a plume out to 100 km or more, with a release on the order of 100 kg of SF6, was validated. If used in conjunction with other real-time instruments for pollutants, such as the chemiluminescent NO monitor, the rate of conversion of the pollutant could be rapidly determined as well as the relative contribution of a source to the pollutant level at a distant location. Preliminary indications offer hope that the halocarbons (CF2Br2 and C2F4Br2) tested in this experiment will prove to be feasible long-range tracers.

Author (NSA)

N73-31765* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

THE FIRST EARTH RESOURCES TECHNOLOGY SATELLITE (ERTS-1)

William Nordberg Aug. 1973 19 p refs Presented at 14th Meeting of COSPAR, Konstanz, West Germany, 25 May 1973 Submitted for Publication

(NASA-TM-X-70462; X-650-73-241) Avail: NTIS HC \$3.00 CSCL 22C

The first Earth Resources Technology Satellite (ERTS-1) makes images of the earth's surface in four portions of the electromagnetic spectrum with sufficient spatial resolution and with a minimum of geometric distortions, so that these images may be applied experimentally to the study of geophysical processes relating to earth resources, to the exploration and conservation of these resources, and to the assessments of environmental stresses. During the first six months of operation, ERTS-1 has imaged 6.5 million square kilometers of the earth's surface every day, covering most major land masses and coastal zones as well as both polar regions of this planet. These images as well as the results of their analyses are available to all people throughout the world. Scientific investigators of all countries have been invited to participate in the utilization of ERTS-1 observations. Many of them have already demonstrated the great efficiency, economy, and reliability of making earth surveys from space. Author

N73-31905* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

EFFECTS OF THE ATMOSPHERE ON ERTS OBSERVATIONS

Robert S. Fraser In *its Significant Accomplishments in Sci.* 1973 p 193-195

CSCL 04A

N73-32215* Geological Survey, Denver, Colo.
REMOTE SENSING GEOPHYSICS FROM SKYLAB Progress Report, Jul. - Aug. 1973
 Kenneth Watson, Principal Investigator Aug. 1973 3 p EREP
 (NASA Order T-6555-B)
 (E73-10998; NASA-CR-133779) Avail: NTIS HC \$3.00 CSCL 08G

N73-32216* Michigan State Univ., East Lansing.
[GROUND TRUTH ACQUISITION] Progress Report, Jul. 1973
 Lester V. Manderscheid, Principal Investigator 19 Sep. 1973 1 p EREP
 (Contract NAS9-13332)
 (E73-11014; NASA-CR-133807) Avail: NTIS HC \$3.00 CSCL 08B

N73-32238* Kansas Univ. Center for Research, Inc., Lawrence. Remote Sensing Lab.
PRELIMINARY REPORT ON SKYLAB S-193 RADSCAT MEASUREMENTS OF HURRICANE AVA Advance Report of Significant Events
 Willard J. Pierson, Jr., Richard K. Moore, Principal Investigators, Vincent J. Cardone, and James D. Young Oct. 1973 18 p refs Prepared in cooperation with City Univ. of New York EREP
 (Contract NAS9-13642)
 (E73-11062; NASA-CR-135518; CUNY-UIO-23; KU-RSL-254-1) Avail: NTIS HC \$3.00 CSCL 04B

The author has identified the following significant results. The Skylab RADSCAT instrument S-193 was operated on 6 June 1973 while the spacecraft flew past Hurricane Ava in the eastern Pacific Ocean. Scatterometer returns at all polarizations and radiometer measurements were obtained from a section through the storm with winds up to 48 knots at 52 deg incident angle and 35 knots at 45.5 deg incident angle. These first hurricane scatterometer measurements indicate reasonable correlation between wind speed and backscatter, with horizontal response much stronger than the vertical response at 52 deg. Each of the sections through the hurricane contains an as yet unexplained dip in cross section at a point 200 to 300 km prior to passing the eye. The response at a point where the radiometer signal's dramatic increase indicates strong rain is also accompanied by a strong increase in the backscattered signal. No attempt has been made to make a thorough correlation of radiometric response with wind speed, but the atmospheric contribution to the radiometer signal is quite apparent.

N73-32299* Plessey Co., Ltd., Havant (England).
MULTISPECTRAL SCANNING SYSTEMS AND THEIR POTENTIAL APPLICATION TO EARTH RESOURCE SURVEYS. VOLUME 7: BIBLIOGRAPHY
 Jun. 1973 82 p refs
 (Contract ESTEC-1673/72-EL)
 (ERL/R-249-U; ESRO-CR(P)-237) Avail: NTIS HC \$6.25

The bibliography includes the following areas data: processing, material properties of vegetation and soils, agriculture, geography, geology, hydrology, and oceanography.

ESRO

N73-32301* Plessey Co., Ltd., Havant (England).
MULTISPECTRAL SCANNING SYSTEMS AND THEIR POTENTIAL APPLICATION TO EARTH RESOURCE SURVEYS. VOLUME 5: RECOMMENDATIONS FOR EUROPEAN PROGRAMME
 A. D. Higham, Q. S. Earl, D. A. Kahn, E. Fitzgerald, and P. B. Wilkinson Mar. 1973 119 p refs
 (Contract ESTEC-1673/72-EL)
 (ERL/R-247-U; ESRO-CR(P)-235) Avail: NTIS HC \$8.00

The implications of multispectral scanning system (MSS) are discussed. Discussion and programs for the extension of European capabilities in the areas of the basic sensing process, the properties

of materials, the MSS instrument, data processing, earth science application, ground truth and education are presented. Both aircraft and satellite carried sensors are considered. The final section identifies the specific programs with some indication of what their content might be and ends with tables of associated cost and program timing estimates. ESRO

N73-32332* Defence Research Establishment Ottawa (Ontario).

A TRIAL OF INFRARED SENSITIVE TELEVISION EQUIPMENT UNDER WHITEOUT CONDITIONS

R. J. Brown and D. J. DiFruscio Aug. 1973 13 p refs
 (DREO-TN-73-11) Avail: NTIS HC \$3.00

The feasibility of using a television camera, sensitive in the near infrared portion of the electromagnetic spectrum, to give depth of field perception and horizon detection in a whiteout was investigated, in February 1973. This approach is based on the fact that the reflectivity of snow decreases considerably in this region of the spectrum from the values in the visible region. This decrease may be sufficient to disturb the balance of conditions required to sustain a whiteout. Author

N73-32342* Aerojet Electrosystems Co., Azusa, Calif.
ELECTRICALLY SCANNING MICROWAVE RADIOMETER FOR NIMBUS E Final Report

Jan. 1973 50 p
 (Contract NAS5-21115)
 (NASA-CR-132812; Rept-1740FR-1) Avail: NTIS HC \$4.50 CSCL 14B

An electronically scanning microwave radiometer system has been designed, developed, and tested for measurement of meteorological, geomorphological and oceanographic parameters from NASA/GSFC's Nimbus E satellite. The system is a completely integrated radiometer designed to measure the microwave brightness temperature of the earth and its atmosphere at a microwave frequency of 19.35 GHz. Calibration and environmental testing of the system have successfully demonstrated its ability to perform accurate measurements in a satellite environment. The successful launch and data acquisition of the Nimbus 5 (formerly Nimbus E) gives further demonstration to its achievement. Author

N73-33243* Kansas Univ. Center for Research, Inc., Lawrence.

DETECTION OF A LOW PRESSURE CENTER FROM ERTS IMAGERY

Stanley Morain, Principal Investigator and Donald L. Williams 9 May 1973 2 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
 (Contract NAS5-21822)
 (E73-10978; NASA-CR-133757; CRINC-DIIR-2246-6) Avail: NTIS HC \$3.00 CSCL 04B

N73-33245* Bureau of Reclamation, Denver, Colo.
MONITOR WEATHER CONDITIONS FOR CLOUD SEEDING CONTROL Progress Report 1 Jul. - 30 Aug. 1973
 Archie M. Kahan, Principal Investigator 30 Sep. 1973 6 p ERTS
 (NASA Order S-70243-AG-8)
 (E73-11071; NASA-CR-135540) Avail: NTIS HC \$3.00 CSCL 04B

N73-33274* National Ocean Survey, Rockville, Md. Photogrammetric Research Branch.

SKYLAB A PROPOSAL AEROTRIANGULATION WITH VERY SMALL SCALE PHOTOGRAPHY Quarterly Report, 15 Jul. - 15 Oct. 1973

Morton Keller, Principal Investigator 15 Oct. 1973 1 p EREP
 (NASA Order T-4110-B)
 (E73-11117; NASA-CR-135592) Avail: NTIS HC \$3.00 CSCL 08B

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N73-33296*# Environmental Research Inst. of Michigan, Ann Arbor.

SKYLAB - WATER DEPTH DETERMINATION Quarterly Progress Report, 1 Jun. - 30 Aug. 1973

Fabian C. Polcyn, Principal Investigator 16 Oct. 1973 3 p EREP

(Contract NAS9-13278)

(E73-11141; NASA-CR-135700; ERIM-102100-5-L; QPR-2)

Avail: NTIS HC \$3.00 CSCL 08H

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Includes economic analysis.

A70-17155

THE EROS (EARTH RESOURCES OBSERVATION SATELLITE) PROGRAM OF THE DEPARTMENT OF THE INTERIOR.

William A. Fischer (U.S. Geological Survey, Washington, D.C.).

Society of Petroleum Engineers of AIME, Annual Fall Meeting, 44th, Denver, Colo., Sept. 28-Oct. 1, 1969, Paper SPE 2703. 4 p.

Description of the EROS program and of its purposes. It is a program to utilize data collected from aircraft and spacecraft for practical resources purposes. Using randomly collected data from Apollo, Gemini, and Mercury space flights, the U.S. Geological Survey has compiled photo mosaics that are map-like in quality of over 1,000,000 square miles of the earth's surface. Using these maps as bases, and the color 'space' photos for interpretation, the Geological Survey scientists have prepared: (1) a geologic terrain map of the southwest United States (essentially a soils-association map), and (2) a land-use planning map of the same region, a tectonic map, and soon will complete a land-use map of the area. Of significance is the 'ability' of space images to peer far beneath the waters of the ocean, thereby, holding promise for increasing the efficiency of resources studies of near shore areas. M.V.E.

A70-22859 # Potential institutional arrangements of organizations involved in the exploitation of remotely sensed earth resources data. T. J. Gordon and S. Enzer (Institute for the Future, Middletown, Conn.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-344. 9 p.* Members, \$1.00; nonmembers, \$1.50.

Exploration of various organizational forms to indicate how well they might respond to the challenges likely to be encountered in providing remotely-based earth resources services. The major problems are political, economic, and technical. Politically, some nations might be sensitive to overfly by earth resources satellites because the data collected might provide economic, military, or agricultural information which could be used to the disadvantage of that nation. Economic issues involve the identification of potential customers and determination of appropriate fee schedules, raising the required capital, and determining the optimum mode of insurance protection. Sensor development, data compression, and information processing are some of the technological problems. Candidate organizational forms for providing earth resources services could be public, private, or international, and each of these is examined. F.R.L.

A70-22860 # Economic factors of Earth Resources Satellite Observation and Information Systems. Mary A. Holman (George Washington University, Washington, D.C.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-333. 6 p.* Members, \$1.00; nonmembers, \$1.50.

Discussion of the broader and institutional framework and some of the pertinent issues relating to Earth Resources Satellite Information Systems. Federal spending for space applications programs, NASA's Space Application Program in relation to national goals, the contribution of cost-effectiveness analysis to policy decisions about earth resources satellites, and the possibility of recovering the cost of Earth Resources Satellite Programs by the sale of satellite-obtained information are discussed. M.M.

A70-22861 # Projected uses of observations of the earth from space—The EROS program of the Department of the Interior.

William A. Fischer (U.S. Survey, Washington, D.C.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-332. 6 p.* Members, \$1.00; nonmembers, \$1.50.

Description of EROS (Earth Resources Observation Satellite), a program to acquire, process, utilize and disseminate remote sensor data collected from aircraft and spacecraft. The EROS Program has identified five broad classes of users of the data to be derived from the NASA ERTS (Earth Resources Technology Satellite). These users are scientists, resources managers, educators, policy makers, and resources producers such as ranchers, farmers, and fishermen. The need for timely data and information is greatest for the resource producers followed, in turn, by the resource managers. Benefits to educators will likely be large but intangible; in earth science education, for example, space data will make possible a shift from the deductive path of reasoning to the inductive path. M.M.

A70-22862 # International legal and political aspects of earth resource surveying by satellite. Robert F. Packard (U.S. Department of State, Office of Space and Environmental Sciences, Washington, D.C.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-331. 5 p.* Members, \$1.00; nonmembers, \$1.50.

This paper attempts to assess the likely international legal and political implications of earth resource surveying by satellite, and to suggest how the United States might best anticipate these implications in its arrangements for the development and use of this capability. The possibility of taking regular inventories of resources, and thereby to achieve a major advance in their management, is so attractive that it tends to obscure difficult technical, economic and political problems yet to be solved. We must assess seriously international opportunities and liabilities which are likely to arise—opportunities to develop new cooperative arrangements and to secure benefits on a global scale; liabilities arising from overexpectations, from proprietary interests, and from matters of priority and use. We must move promptly and openly to develop this capability seeking maximum foreign participation from the outset and making sure that these arrangements are consistent with the particular characteristics of this new technology as it unfolds. (Author)

A70-22881 # Resource policy, management, and remote sensing. R. Keith Arnold (U.S. Forest Service, Washington, D.C.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-304. 5 p.* Members, \$1.00; nonmembers, \$1.50.

Discussion of the critical need and feasibility of information systems operating in near-real time to continuously monitor the production of the world's food, fiber, and other natural resources, and measure and monitor environmental changes on spaceship earth. The potential applications of remote sensing to the more timely and efficient accomplishment of agriculture and forestry jobs are discussed, together with the benefits to be derived from the ERTS (Earth Resources Technology Satellite) Program. M.M.

A70-22883 # Future applications of earth resource surveys from space. Charles J. Robinove (U.S. Geological Survey, Washington, D.C.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-302. 4 p.* Members, \$1.00; nonmembers, \$1.50.

Review of the technology and future applications of spacecraft-borne sensors for earth resource surveys. A philosophy of resource surveying from space and the first satellite specifically devoted to it and to be launched in 1972, ERTS-A, are discussed. Future applications of spacecraft-borne sensors for resource surveys

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are expected to be widespread in the exploration, development and management of resources. M.V.E.

A70-22890 # An operational Earth Resource Satellite System—What does the user expect? Homer A. Humiston (Westinghouse Electric Corp., Aerospace Div., Baltimore, Md.). *American Institute of Aeronautics and Astronautics, Earth Resources Observations and Information Systems Meeting, Annapolis, Md., Mar. 2-4, 1970, Paper 70-293*. 8 p. Members, \$1.00; nonmembers, \$1.50. U.S. Geological Survey Contract No. 14-08-001-10915.

A method is developed by which user information traffic can be forecast for an operational system. When applications are arranged as to their data obsolescence characteristics, a pattern of user expectations emerges. The bulk of system traffic can be expected from consumers who may be least able to perform the necessary enhancements, yet previous study of Interior Department applications suggests these same uses will offer very large benefits. Accommodating such customers will require a complex and highly-responsive, general-purpose, data processor. The main purpose of an operational system emerges as the provision of answers rather than data as inputs to user management decision processes. When a sufficient fund of remote sensor/signature technology has been established, then viable system growth will be paced by user demand which first must be developed through education and then fulfilled routinely. (Author)

A70-23333 * Space research and a better earth. Thomas O. Paine (NASA, Washington, D.C.). *Impact of Science on Society*, vol. 19, Apr.-June 1969, p. 123-134.

Review of some of the new satellite uses that are likely to be made possible by advances in space technologies for studying and monitoring the earth's ecosystem. Recommendations for environmental space research and the assignment of priorities in the space program are discussed. Special attention is given to the enormous potential of satellites, linked with powerful computers, in such areas as meteorology, natural resources surveys, world-wide communications, navigation and the control of air and sea traffic, and geographic mapping and geodesy. M.V.E.

A70-23762 * Operational planning for global earth surveys using space vehicles. Peter Bock, John G. Barmby (IIT Research Institute, Chicago, Ill.), and Robert Dubinsky (Geonautics, Inc., Washington, D.C.). In: *Photo-optical instrumentation applications and theory; Society of Photo-optical Instrumentation Engineers, Annual Technical Symposium and Exhibitorama, 14th, San Francisco, Calif., August 11-14, 1969, Proceedings. Volume 2.* Symposium co-sponsored by the U.S. Army and the U.S. Air Force. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1969, p. 199-206. Contract No. NASr-65(10).

Discussion of the planning necessary for observational experiments leading to operational Earth Resource Surveys. The planning involved for experiments, which are to be conducted over a period of several months, will have to optimize the periods of operation with regard to the objective and imposed constraints. Operational profiles were determined for two global experiments considered typical of those which might be conducted in the mid-1970's. The basic method employed was the Experiment Profile Analysis technique. F.R.L.

A70-24075 Photo interpretation, with examples of its usefulness. D. Galmier and R. Lacot. *Photogrammetria*, vol. 25, Feb. 1970, p. 131-146.

Discussion of examples which show that a photo interpreter is able to deal readily and accurately with problems of economical value. The examples presented involve the detection of a kaolin deposit, a railway problem, and a case of some value for civil engineering and drawing of the geological map. It is pointed out that

in each case a few hours of a photo interpreter's work were sufficient to detect and analyze the problems. G.R.

A70-24635 Earth observation satellites; British Interplanetary Society and NATO, International Summer School on Earth Resources Survey Satellites, Gonville and Caius College, Cambridge, England, July 14-25, 1969, Proceedings. *British Interplanetary Society, Journal*, vol. 23, Apr. 1970. 77 p.

Contents:

Address of welcome. L. R. Shepherd, p. 249, 250.

Special message. A. H. Abdel-Ghani (United Nations, New York, N.Y.), p. 250.

The Earth Resources Observation Satellite Program. E. S. Burnett (TRW Systems Group, Redondo Beach, Calif.), p. 251-256. 9 refs.

Earth Resources Satellite Systems. D. W. Keller (General Electric Co., Valley Forge, Pa.), p. 257-274.

Tangible results achieved by earth observation satellites to date. E. S. Burnett (TRW Systems Group, Redondo Beach, Calif.), p. 275-283. 8 refs.

The Tiros M satellite in an ERTS role. C. R. Hume (RCA, Princeton, N.J.), p. 285-289.

The measurement of ozone from a satellite. D. E. Miller (Meteorological Office, Bracknell, Berks., England), p. 291-296. 8 refs.

Assessment of satellite photographs for geological mapping and research. J. A. E. Allum (Institute of Geological Sciences, London, England), p. 297-306. 9 refs.

Small payload potential for earth resources. A. I. Sibila (LTV Aerospace Corp., Dallas, Tex.), p. 307-323. 7 refs.

The contribution of satellite geodesy to the determination of the figure and the internal constitution of the earth. E. Groten (München, Technische Hochschule, Munich, West Germany), p. 325-328.

A70-24636 # The Earth Resources Observation Satellite Program. E. S. Burnett (TRW Systems Group, Redondo Beach, Calif.). (*British Interplanetary Society and NATO, International Summer School on Earth Resources Survey Satellites, Gonville and Caius College, Cambridge, England, July 14-25, 1969.*) *British Interplanetary Society, Journal*, vol. 23, Apr. 1970, p. 251-256. 9 refs.

Summary of the topics discussed at the International NATO Summer School, which met during the period from July 14 to 25, 1969, in Cambridge, England under the sponsorship of the British Interplanetary Society. The works discussed outline the benefits already realized and still anticipated from the unmanned and manned earth observation satellite programs. Possible areas of international cooperation are considered, and the identification of specific goals is examined. T.M.

A70-24641 # Small payload potential for earth resources. Alfred I. Sibila (LTV Aerospace Corp., Dallas, Tex.). (*British Interplanetary Society and NATO, International Summer School on Earth Resources Survey Satellites, Gonville and Caius College, Cambridge, England, July 14-25, 1969.*) *British Interplanetary Society, Journal*, vol. 23, Apr. 1970, p. 307-323. 7 refs.

Review of the applications of small spacecraft to earth resources survey endeavors. The capability of small boosters, such as the Scout launch vehicle, to place payload weights into circular, elliptical, and low earth orbits is presented. Particular attention is paid to recurring sun-synchronous orbits, including the conditions necessary to establish such precise orbits. Typical launch sites available and the earth coverage provided from each are illustrated. The state-of-the-art developments leading to the ability to configure spacecraft to meet the weight and volume limitations of small payloads are explored and illustrated with examples of typical spacecraft designs. Two approaches for small earth-resources payloads emerge. One is the

systems-oriented concept with full capability for orbit correction to accurate sun-synchronous near-recursion orbits. This concept will probably be limited to one or two sensors and would have onboard data storage. The other approach is a simpler concept, where orbital accuracy and lighting conditions are traded for greater experimental weight. In keeping with a low-cost approach, the data handling for the latter concept centers around real-time transmission. The results show that it is possible to configure small payloads and place them in orbits suitable for earth-survey purposes. It is concluded that small satellites can be effectively utilized in the earth-resources survey programs and that mission selection and funding are likely to be more serious obstacles than spacecraft technology in pursuing such a course of action. (Author)

A70-24875 Space vehicles of the seventies (*Raumfahrzeuge der siebziger Jahre*). A. K. Thiel (TRW, Inc., Cleveland, Ohio). *Flugrevue/Flugwelt International*, Apr. 1970, p. 43-46, 51. In German.

Discussion of the scope and the main features of the space program of the TRW for the years up to 1978. The installation of an optical observatory on the moon and of a radioastronomical observatory in orbit is discussed. Investigations of spacecraft concepts for exploration of the planets are considered. Satellite applications in the fields of communication and navigation are described. Other satellite applications discussed are connected with cartographical and meteorological objectives and a survey of the natural resources of the earth. G.R.

A70-26901 International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969, Proceedings. Volume 2. Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969. 687 p. Price of two volumes, \$15.

Contents:

Oceanographic applications of remote sensing. I.

Passive microwave sensors for satellites. J. W. Sherman, III (U.S. Naval Oceanographic Office, Washington, D.C.), p. 651-669. 21 refs.

Time-space variations of the Gulf Stream as observed by airborne remote sensing techniques. J. C. Wilkerson and V. E. Noble (U.S. Naval Oceanographic Office, Washington, D.C.), p. 671-708.

Remote sensing of the sea conditions with microwave radiometer systems. J. C. Auckland, P. J. Caruso, Jr., W. H. Conway (Microwave Sensor Systems, Inc., Downey, Calif.), and R. G. Groshans (RCA, Princeton, N.J.), p. 709-719.

Manned submersible optical remote sensing within the Gulf Stream. W. G. Egan (Grumman Aerospace Corp., Bethpage, N.Y.), p. 721-735.

The remote sensing of the sea and sea ice. N. W. Guinard (U.S. Navy, Naval Research Laboratory, Washington, D.C.), p. 737-754. 9 refs.

Multispectral sensing of oil pollution. D. S. Lowe and P. G. Hasell (Michigan, University, Ann Arbor, Mich.), p. 755-765.

Oceanographic applications of remote sensing with passive microwave techniques. A. T. Edgerton and D. T. Trexler (Aerojet-General Corp., El Monte, Calif.), p. 767-788. 8 refs.

Detection of oil slick pollution on water surfaces with microwave radiometer systems. J. C. Auckland, W. H. Conway (Microwave Sensor Systems, Inc., Downey, Calif.), and N. K. Sanders (California, University, Santa Barbara, Calif.), p. 789-796.

The effect of sea roughness on the bandwidth of radar backscatter. D. L. Hammond (U.S. Navy, E. O. Hulburt Center for Space Research, Washington, D.C.), p. 797-806.

Geographic applications of remote sensing.

Extraction of urban data from high and low resolution images. D. F. Marble (Northwestern University, Evanston, Ill.) and F. E. Horton (Iowa, University, Iowa City, Iowa), p. 807-818. 5 refs.

Urban spatial structure based on remote sensing imagery. R. K. Holz, D. L. Huff, and R. C. Mayfield (Texas, University, Austin, Tex.), p. 819-830.

The role of space photography in urban and transportation data series. B. S. Wellar (Kansas, University, Lawrence, Kan.), p. 831-854. 26 refs.

On the use of space photography for identifying transportation routes - A summary of problems. D. S. Simonett, F. M. Henderson, and D. D. Egbert (Kansas, University, Lawrence, Kan.), p. 855-877.

Detection of linear cultural features with multipolarized radar imagery. A. J. Lewis, H. C. MacDonald, and D. S. Simonett (Kansas, University, Lawrence, Kan.), p. 879-893. 14 refs.

Computer-processing and classification of multi-variate information from remote sensing imagery. D. Steiner (Waterloo, University, Waterloo, Ontario, Canada), K. Baumberger and H. Maurer (Zürich, Universität, Zurich, Switzerland), p. 895-907.

APQ-97 imagery of New England - A geographic evaluation. R. B. Simpson (Dartmouth College, Hanover, N.H.), p. 909-925.

Slope failure forms - Their identification, characteristics, and distribution as depicted by selected remote sensor returns. D. H. Poole (East Tennessee State University, Johnson City, Tenn.), p. 927-965. 94 refs.

Geopedological features derived from satellite measurements in the 3.4-4.2 micron and 0.7-1.3 micron spectral regions. J. Pouquet (NASA, Goddard Space Flight Center, Greenbelt, Md.), p. 967-988. 8 refs.

On the detection of pesticidal fallout by remote sensing techniques. M. C. Kolipinski and A. L. Higer (U.S. Geological Survey, Washington, D.C.), p. 989, 990.

Oceanographic applications of remote sensing. II.

Remote measurement of ocean color as an index of biological productivity. G. L. Clarke, G. C. Ewing, and C. J. Lorenzen (Woods Hole Oceanographic Institution, Woods Hole, Mass.), p. 991-1001.

Spectral reflectance of aquarium plants and other natural underwater materials. D. L. Spooner (Lockheed Electronics Co., Houston, Tex.), p. 1003-1016.

Water depth determinations using remote sensing techniques. F. C. Polcyn and I. J. Sattinger (Michigan, University, Ann Arbor, Mich.), p. 1017-1028.

Enhanced oceanographic imagery. D. S. Ross (Philco-Ford Corp., Palo Alto, Calif.), p. 1029-1044.

Remote sensing by aerial color photography for water depth penetration and ocean bottom detail. W. E. Vary (U.S. Naval Oceanographic Office, Washington, D.C.), p. 1045-1059.

The airborne pulsed neon blue-green laser - A new oceanographic remote sensing device. G. D. Hickman (Exotech, Inc., Rockville, Md.), J. E. Hogg, A. R. Spadaro (Syracuse University Research Corp., Syracuse, N.Y.), and M. Felscher (American Geological Institute, Washington, D.C.), p. 1061-1074.

Infrared exploration for shoreline springs at Mono Lake, California, test site. K. Lee (Colorado School of Mines, Golden, Colo.), p. 1075-1100.

Upwelling, Columbia River plume and albacore tuna. W. G. Percy and J. L. Mueller (Oregon State University, Corvallis, Ore.), p. 1101-1113.

Agriculture-forestry applications of remote sensing.

Relationship of film optical density to yield indicators. D. H. Von Steen (U.S. Department of Agriculture, Washington, D.C.), R. W. Leamer, and A. H. Gerbermann (U.S. Department of Agriculture, Weslaco, Tex.), p. 1115-1122.

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Relation of light reflectance to cotton leaf maturity (*Gossypium hirsutum* L.). H. W. Gausman, W. A. Allen, R. Cardenas, and A. J. Richardson (U.S. Department of Agriculture, Weslaco, Tex.), p. 1123-1141. 35 refs.

Discrimination of vegetation by multispectral reflectance measurements. A. J. Richardson, W. A. Allen, and J. R. Thomas (U.S. Department of Agriculture, Weslaco, Tex.), p. 1143-1156. 17 refs.

Sampling forest insect epidemics with color films. R. C. Heller and J. F. Wear (U.S. Department of Agriculture, Berkeley, Calif.), p. 1157-1167.

A system for using remote sensing techniques to detect and evaluate air pollution effects on forest stands. S. L. Wert (U.S. Department of Agriculture, Berkeley, Calif.), p. 1169-1178.

New multi-stage sampling techniques using space and aircraft imagery for forest inventory. P. G. Langley (U.S. Department of Agriculture, Berkeley, Calif.), p. 1179-1192. 7 refs.

Remote sensing of lightning in forest fire research. R. G. Have and D. M. Fuquay (U.S. Department of Agriculture, Ogden, Utah), p. 1193-1203.

The significance of changes in infrared reflectance in sugar maple (*Acer Saccharum* Marsh), induced by soil conditions of drought and salinity. J. M. Ward (Michigan, University, Ann Arbor, Mich.), p. 1205-1226.

Remote sensing of time dependent phenomena. A. B. Park (U.S. Department of Agriculture, Washington, D.C.), p. 1227-1236.

Remote sensing of the arid zone vegetation in the visible spectrum for studying the productivity. B. V. Vinogradov (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR), p. 1237-1250. 30 refs.

Extraterrestrial applications of remote sensing.

Remote sensing of the universe at large - An iconoclastic approach to astronomical cosmology. R. Wildey (U.S. Geological Survey, Flagstaff, Ariz.), p. 1251-1267. 65 refs.

Analysis of the goniophotometric properties of lunar 'rolling stones.' D. L. Spooner (Lockheed Electronics Co., Houston, Tex.), p. 1269-1290. 6 refs.

Remote sensing of the lunar photometric function from the orbiting Apollo command service module. R. Wildey, H. Pohn (U.S. Geological Survey, Flagstaff, Ariz.), D. Tompkins, D. Calvert, W. Longyear (Philco-Ford Corp., Newport Beach, Calif.), and H. Radin (Bellcomm, Inc., Washington, D.C.), p. 1291-1303. 8 refs.

An IR spectrophotometer for investigation of the surface of Mars. A. B. Binder and J. C. Jones (IIT Research Institute, Chicago, Ill.), p. 1305-1319. 5 refs.

Discrimination of possible Martian surface constituents by multispectral imaging. V. Klemas and E. L. G. Odell (General Electric Co., Philadelphia, Pa.), p. 1321-1347. 10 refs.

Closing comments at the Sixth International Symposium on Remote Sensing of Environment. G. J. Zissis (Michigan, University, Ann Arbor, Mich.), p. 1349.

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A70-26942 * # Systems analysis techniques in earth resources satellite systems planning. Robert A. Summers (NASA, Washington, D.C.). In: International Symposium on Remote Sensing of Environment, 6th, Ann Arbor, Mich., October 13-16, 1969; Proceedings. Volume 1.

Symposium sponsored by the University of Michigan, the U.S. Geological Survey, the U.S. Department of Agriculture, the Environmental Science Services Administration, and the U.S. Coast Guard. Ann Arbor, Mich., Michigan, University, 1969, p. 237-246. Contract No. NASw-1816.

Through the use of modeling techniques and multi-stage relevance matrices, an analytical format is developed for synthesizing and examining future operational Earth resources survey systems.

The procedure also gives promise of utility in planning the extensive R&D efforts which must precede most operational systems. A critical need is identified for the development of Earth-science-based predictive models which can make effective use of the synoptic, repetitive data characteristics of spacecraft-based observation systems. The first order interaction of meteorological models in many cases is also noted. (Author)

A70-27741 Manned laboratories in space; International Academy of Astronautics, International Astronautical Congress, 19th, International Orbital Laboratory Symposium, 2nd, New York, N.Y., October 18, 1968, Proceedings. Edited by S. F. Singer (U.S. Department of the Interior, Washington, D.C.). Dordrecht, D. Reidel Publishing Co. (Astrophysics and Space Science Library. Volume 16), 1969. 144 p. \$9.90.

Contents:

Preface. W. Von Braun. 1 p.

Editor's prologue. S. F. Singer, p. vii-xi.

Manned space stations - Gateway to our future in space. R. R. Gilruth (NASA, Manned Spacecraft Center, Houston, Tex.), p. 1-10.

Critical engineering problems of space stations. T. J. Gordon and R. L. Gervais (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.), p. 11-32.

The research potential of manned earth orbiting spacecraft for meteorology. S. F. Singer (U.S. Department of the Interior, Washington, D.C.), p. 33-45. 5 refs.

Terrain spectral imagery from space in various spectral regions. K. Ia. Kondrat'ev, V. D. Stepanenko, and B. V. Vinogradov (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR), p. 46-67. 83 refs.

Spacecraft for ocean exploration. E. Wenk, Jr. (National Council on Marine Resources and Engineering Development, Washington, D.C.), p. 68-74. 5 refs.

Earth resource observations from an orbiting spacecraft. W. T. Pecora (U.S. Geological Survey, Washington, D.C.), p. 75-87.

Astronomical research with a large orbiting telescope. L. Spitzer, Jr. (Princeton University, Princeton, N.J.), p. 88-98.

Orbital laboratory - Stepping stone to interplanetary flight. W. M. Hollister (MIT, Cambridge, Mass.), p. 99-109. 15 refs.

Manned flight to the nearer planets. S. F. Singer (U.S. Department of the Interior, Washington, D.C.), p. 110-115. 5 refs.

Index of subjects, p. 131-133.

A70-27747 Earth resource observations from an orbiting spacecraft. W. T. Pecora (U.S. Geological Survey, Washington, D.C.). In: Manned laboratories in space; International Academy of Astronautics, International Astronautical Congress, 19th, International Orbital Laboratory Symposium, 2nd, New York, N.Y., October 18, 1968, Proceedings. Edited by S. F. Singer. Dordrecht, D. Reidel Publishing Co. (Astrophysics and Space Science Library. Volume 16), 1969, p. 75-87.

Consideration of the advantages to geologists of receiving images of the earth from space, thus enabling them to construct photo-image maps of the continents and the surrounding shelves. Such maps will enable them to focus inward on problems of interest, and will assist in classifying terrain or recognizing anomalies that warrant further investigation. Not only will geologists be able to study the major mountain chains and their various structural elements, but they will in time be able to compare the surface changes that take place through the years. Volcanic eruptions, earthquakes, forest fires, and floods and their effects on erosion will be monitored and assessed from space in a rapid and timely manner. Other time-variant phenomena such as shore processes, estuarine changes, delta formation, sand dune development, and the growth or destruction of atolls will be permanently recorded and their changes mapped. F.R.L.

A70-31713 # Report on space research activity in Hungary. COSPAR, Plenary Meeting, 13th, Leningrad, USSR, May 20-29, 1970, Paper, 4 p. 13 refs.

Review of space research activities at various Hungarian scientific institutes for 1969. Optical observations of artificial satellites were carried out at three stations, and the geomagnetic effect in the upper atmosphere was investigated by means of the PERLO computer program. A method was developed for the connection and common adjustment of the geodetic data deduced from satellite observations and from conventional geodetic measurements. Geophysical, meteorological, and cosmic-ray studies were conducted.

F.R.L.

A70-31719 # Space research in the Netherlands - 1969. COSPAR, Plenary Meeting, 13th, Leningrad, USSR, May 20-29, 1970, Paper 23 p. 35 refs.

Review of space research activities conducted in the Netherlands during 1969, and description of some of the main results obtained. The organizational structure of space research is outlined, and the tasks performed by the various working groups are detailed. Rocket launchings for solar and stellar studies are tabulated, and descriptions are given of experiments involving solar and stellar X-radiation and UV spectrophotometry. Cosmic-ray measurements are treated, along with research in photometry and satellite geodesy.

T.M.

A70-32062 Astronautics - An outline of utility. Harry O. Ruppe (München, Technische Hochschule, Munich, West Germany). In: Advances in space science and technology. Volume 10.

Edited by F. I. Ordway, III. New York, Academic Press, Inc., 1970, p. 139-271. 164 refs.

Discussion of the utility of astronautics taking into consideration present accomplishments and some speculative possibilities for the future. Aspects of the obvious utility of space flight in astronomy, physics, and in commercial, military, meteorological and navigational applications are considered. Fringe benefits and the cost of astronautics are discussed. It is shown that the technology to be developed for the solution of the problems of extraterrestrial settlements should also prove of value for terrestrial applications. Aspects of space exploration which go beyond mere utility are considered.

G.R.

A70-32283 # Utility of space enterprises (Utilità delle imprese spaziali). Manlio Lo Cascio (Sna Viscosa, Rome, Italy). In: Evolution of space propulsion in the '70s; International Technical and Scientific Conference on Space, 10th, Rome, Italy, March 9-11, 1970, Official Proceedings (L'Evoluzione della propulsione spaziale negli anni '70; Convegno Internazionale Tecnico-Scientifico sullo Spazio, 10th, Rome, Italy, March 9-11, 1970, Atti Ufficiali).

Convention sponsored by the Ministero degli Affari Esteri and the Associazione Industrie Aerospaziali. Rome, Rassegna Internazionale Elettronica Nucleare e Teleradiocinematografica, 1970, p. 431, 433-436. In Italian.

Assessment of the value of space research in an effort to counter unfavorable criticism of space programs as being wasteful and useless. Numerous advantages of satellites in the fields of weather forecasting, television broadcasting, space biology and medicine, geodesy, aerial and maritime navigation, and earth resources studies are cited as more than amply justifying the continuation of space research. The development of new high-strength, lightweight materials is also cited as a beneficial by-product of space research.

A.B.K.

A70-33701 Technology today and tomorrow; Canaveral Council of Technical Societies, Space Congress, 7th, Cocoa Beach, Fla., April 22-24, 1970, Proceedings. Volume 1. Edited by T. H. Hanrahan (Aerospace Corp., El Segundo, Calif.). Cape Canaveral, Fla., Canaveral Council of Technical Societies, 1970. 621 p. Price of two volumes, \$20.

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Design, fabrication and test of a boron wing structure. A. August, A. London, and W. Ludwig (Grumman Aerospace Corp., Bethpage, N.Y.), p. 1-15 to 1-27.

Separation dynamics of multibody clusters of hinged and/or linked lifting-entry vehicles. M. J. Hurley, Jr. and M. J. Lanfranco (General Dynamics Corp., San Diego, Calif.), p. 1-29 to 1-52. 8 refs.

Cobalt-base alloys in aerospace. F. R. Morral (Battelle Memorial Institute, Columbus, Ohio), p. 1-53 to 1-63. 24 refs.

Space shuttle booster configuration features. R. A. Lynch (General Dynamics Corp., San Diego, Calif.), p. 1-65 to 1-79.

Astronaut maneuvering research vehicle. J. R. Tewell (Martin Marietta Corp., Denver, Colo.), p. 1-81 to 1-88. (See

Earth resources satellites application.

Practical applications of sequential pattern recognition techniques. R. Newman and B. Reisine (Purdue University, Lafayette, Ind.), p. 2-1 to 2-9.

Some shifting relationships between the user community and the Earth Resources Program. A. H. Muir (Earth Satellite Corp., Washington, D.C.), p. 2-11 to 2-14. 6 refs.

Advanced techniques in education.

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Education - The crisis and a plan. H. A. Blum (Southern Methodist University, Dallas, Tex.), p. 3-5 to 3-14.

A large scale computer-based educational system for the seventies. D. L. Bitzer and D. Skaperdas (Illinois University, Urbana, Ill.), p. 3-15 to 3-26.

Sensitivity techniques in learning. M. I. Veiner (Florida State University, Patrick AFB, Fla.), p. 3-27 to 3-34.

Engineering applications in medicine.

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The interaction of life sciences and engineering technologies in man/system integration. W. W. Murphy, J. R. Swink (General Electric Co., Daytona Beach, Fla.), and E. J. McLaughlin (NASA, Office of Manned Space Flight, Washington, D.C.), p. 4-29 to 4-32.

Future electronic/electrical space vehicle systems.

Optical communications using gallium arsenide injection lasers. J. A. Boyd and R. H. Nelson (Radiation, Inc., Melbourne, Fla.), p. 5-1 to 5-10. 6 refs.

Advanced space power systems. R. R. Bathelemy (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio) and H. A. MacEwen (USAF, Space and Missile Systems Organization, Los Angeles Air Force Station, Calif.), p. 5-11 to 5-12.

Selection and preliminary design of light-weight, low-cost X-band aircraft antennas for defense satellite communications. K. G. Schroeder (TRW Systems Group, Redondo Beach, Calif.), p. 5-23 to 5-29.

Oceanographic projects.

Forecast of world ocean objectives. L. V. Stover (Oceans

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General, Inc., Miami, Fla.), p. 6-1 to 6-4.

The use of satellite cloud photography to infer oceanographic phenomena. J. R. Greaves and C. J. Bowley (Allied Research Associates, Inc., Concord, Mass.), p. 6-5 to 6-15. 16 refs.

Astronaut restraints for the aquanaut. G. W. O'Neil, Jr. (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.), p. 6-17 to 6-26.

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Trade off analysis of pulse compression for a satellite radar altimeter. C. J. Mundo (Raytheon Co., Wayland, Mass.), p. 6-49 to 6-64. 7 refs.

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Unique manufacturing processes in space environment. H. F. Wuenschel (NASA, Marshall Space Flight Center, Huntsville, Ala.), p. 7-1 to 7-10. 8 refs.

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Selected examples for space manufacturing processes, facilities, and experiments. W. H. Steurer (General Dynamics Corp., San Diego, Calif.), p. 7-23 to 7-53. 9 refs.

Chemical and biochemical space manufacturing. C. L. Kober (Martin Marietta Corp., Denver, Colo.), p. 7-55 to 7-64. 9 refs.

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X-ray and gamma-ray astronomy at the turning point. L. E. Peterson (California, University, La Jolla, Calif.), p. 8-1 to 8-26. 40 refs.

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Experiment checkout during postmanufacturing checkout of the Apollo telescope mount. L. M. Hendrix and J. C. Kandiko (General Electric Co., Huntsville, Ala.), p. 8-33 to 8-45.

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A satellite analysis of twin tropical cyclones in the western Pacific. J. L. Cox and G. Jager (U.S. Weather Bureau, Washington, D.C.), p. 11-1 to 11-18.

The hurricane modification project - Past results and future prospects. R. C. Gentry (ESSA, Miami, Fla.), p. 11-19 to 11-28.

Satellite-observed sunglint patterns - Unusual dark patches. C. J. Bowley (Allied Research Associates, Inc., Concord, Mass.), p. 11-29 to 11-39. 11 refs.

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Interactive computer graphics - An advanced computer technology. G. V. J. Yuscavage (Boeing Co., Huntsville, Ala.), p. 12-1 to 12-7.

Interactive computer graphics applied to continuous systems simulation. B. J. Schroer (Boeing Co., Huntsville, Ala.), p. 12-9 to 12-17. 13 refs.

Image enhancement techniques. D. B. Gennery (RCA, Patrick AFB, Fla.), p. 12-19 to 12-36.

Case study in digital simulation. B. L. Capehart (Florida, University, Orlando, Fla.) and R. M. Strong (Martin Marietta Corp., Orlando, Fla.), p. 12-37 to 12-45. 9 refs.

A new multiple access technique for use with satellite networks. E. Thomas (Page Communications Engineers, Inc., Washington, D.C.), p. 12-47 to 12-51.

Broadcast opportunities with satellites and CATV, and their control in the public interest. J. L. Hult (RAND Corp., Santa Monica, Calif.), p. 12-53 to 12-60.

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Some shifting relationships between the user community and the Earth Resources Program. Allan H. Muir (Earth Satellite Corp., Washington, D.C.). In: Technology today and tomorrow; Canaveral Council of Technical Societies, Space Congress, 7th, Cocoa Beach, Fla., April 22-24, 1970, Proceedings. Volume 1. Edited by T. H. Hanrahan. Cape Canaveral, Fla., Canaveral Council of Technical Societies, 1970, p. 2-11 to 2-14. 6 refs.

Discussion of the optimal use of remotely sensed data generated by the NASA Earth Resources Program by matching user models with the potential capabilities of an aircraft/satellite remote sensing system. On a regional hydrology and a wheat rust control example, it is demonstrated that the remote sensors must generate quite different data than is usually requested and that, in modifying the user-decision model, a new view of nature is required. To optimize the Earth Resources Program, research efforts should move away from the pursuit of higher resolutions on the sensor side to improve decision models and data handling systems on the software side.

O.H.

A70-35776

International Astronautical Federation. Colloquium on the Law of Outer Space, 12th, Mar del Plata, Argentina, October 5-10, 1969, Proceedings. Edited by M. D. Schwartz (California, University, Davis, Calif.). Davis, California, University, 1970. 339 p. \$17.50. In English, Spanish, French, and German.

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Legal problems of telecommunications, including direct broadcasting from outer space.

Legal problems of telecommunications, including direct broadcasting from outer space. A. A. Cocca, V. S. Vereshchetin, and Pompeo Magno, p. 7-15. 13 refs.

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Liability for damages caused by space objects including weather control from outer space. J. Rajska (Warszawa, Uniwersytet, Warsaw, Poland), p. 69-77. 5 refs.

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Legal status of earth-orbiting stations.

Juridical condition of earth-orbiting stations. A. A. Cocca, p. 99-101. 6 refs.

The juridical status of rocket-launching stations and of cosmic stations in international law (Statut juridique des stations de lancement de fusées et de stations cosmiques dans le droit international). S. Jelica, p. 105-109. 7 refs.

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Registration of objects sent into space and intended to permit exploration or utilization of extra-atmospheric space (L'immatriculation des objets envoyés dans l'espace et destinés à permettre l'exploration ou l'utilisation de l'espace extra-atmosphérique). J. Massot (Centre National d'Etudes Spatiales, Paris, France), p. 124-126.

Registration of the launching of space objects by Secretary-General of the United Nations. G. P. Zhukov, p. 127-130. 12 refs.

Activities on celestial bodies including the exploitation of natural resources.

Property in moon samples and things left upon the moon. C. W. Jenks, p. 148-152.

Legal aspects of the lunar landing. E. Brooks, p. 160-175. 34 refs.

Activities on celestial bodies including the exploitation of possible natural resources there. L. Szalóky, p. 176-178.

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Some considerations on the lunar product (Algunas consideraciones sobre el producto lunar). M. E. Picarel, p. 189-194. 8 refs.

Activities on celestial bodies, including exploitation of natural resources. O. Fernández-Brital (Morón, Universidad, Morón; Universidad del Salvador, Buenos Aires, Argentina), p. 195-198. 12 refs.

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The principal sources of space law (Las fuentes principales del derecho espacial). Fr. W. von Rauchhaupt (Heidelberg, Universität, Heidelberg, West Germany), p. 201-208.

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Two emerging problems of space law concerning remote sensing satellites. G. J. Alexander, p. 258-263. 36 refs.

Some observations on legal problems in connection with satellite communications. E. Pioman, p. 264-269.

Symposium on the teaching of space law.

Inquiry on the teaching and study of space law in the world (Enquête sur l'enseignement et l'étude du droit de l'espace dans le monde). E. Pépin (International Institute of Space Law, Paris, France), p. 291-324. 100 refs.

A70-35799 # Two emerging problems of space law concerning remote sensing satellites. George J. Alexander. In: International Astronautical Federation, Colloquium on the Law of Outer Space, 12th, Mar del Plata, Argentina, October 5-10, 1969, Proceedings. Edited by M. D. Schwartz. Davis, California, University, 1970, p. 258-263. 36 refs.

Discussion of the need for reexamining the law of various states taking into account the full utilization of the greatly accelerated information flow due to the earth resource survey (ERS) satellites without giving economic advantage to speculators, and the control of experiments designed to alter biospheric conditions. The advantages of the ERS satellites are discussed and the economic benefits of an operational ERS system are examined. The technical and legal problems involved in the dissemination of the ERS information are described. It is also indicated that at present there is no federal law in the United States governing weather modification activities. The need for such regulations is stressed. Z.W.

A70-36297 # International aspects of Earth Resources Survey Satellite programs. John Hanessian, Jr. (George Washington University, Washington, D.C.). (British Interplanetary Society, International Summer School on Earth Observation Satellites, Cambridge, England, July 14-25, 1969.) British Interplanetary Society, Journal, vol. 23, Aug. 1970, p. 533-557. 64 refs.

Discussion of the principal features of Earth Resources Survey Satellite programs and problems associated with potential international participation. Following brief introductory notes on the concept and initiation of the Earth Resources Technology Satellite (ERTS) program developed by NASA, various technical features of this program are described in sufficient detail to highlight effectively certain policy problems linked to the aspects of the system. In particular, the following steps involved in developing and operating the ERTS are considered: definition of requirements and potential users; sensor and spacecraft design; launch of satellite; system control and data acquisition; and data processing, analysis, and use. Technical constraints of the system on international participation are then examined, and the U.S. foreign policy considerations regarding international participation in the ERTS program are outlined. Finally, possible forms of international participation in ERTS are analyzed and, in particular, participation by the USSR is examined. O.H.

A70-37387 Observation of the earth from space (L'observation de la terre depuis l'espace). Jean René Germain. Forces Aériennes Françaises, July 1970, p. 49-69. In French.

Review of methods developed for observation of the earth from satellites, either by human operators or by automatic methods. Some results obtained are outlined and photographs are presented. The principal fields of application are cartography, geography, hydrology, oceanography, the struggle against pollution, agriculture, and geology. The NASA Earth Resources Technological Satellite (ERTS) is discussed in some detail. F.R.L.

A70-39051 Princeton University, Conference on Aerospace Methods for Revealing and Evaluating Earth's Resources, Princeton University, Princeton, N.J., September 25, 26, 1969, Proceedings. Edited by J. P. Layton (Princeton University, Princeton, N.J.). Princeton, N.J., Princeton University Conference, 1970. 320 p. \$10.00.

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Frame type imaging sensors. G. Barna (RCA, Princeton, N.J.), p. 1.1-1.20.

Scanning type imaging sensors. V. T. Norwood (Hughes Aircraft Co., Los Angeles, Calif.), p. 2.1-2.8.

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Correlation spectrometry applied to earth resources. A. R. Barringer (Barringer Research, Ltd., Toronto, Canada), p. 4.1-4.37.

Technological possibilities of the earth resources program. D. J. Fink (General Electric Co., Philadelphia, Pa.), p. 5.1-5.7.

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Data management.

Ground data processing considerations for earth resource information. L. E. Mumbower (IBM Corp., Gaithersburg, Md.), p. 8.1-8.26.

User data processing requirements. H. Gurk (RCA, Hightstown, N.J.), p. 9.1-9.15.

An earth resources satellite system in a political light. J. E. Karth (U.S. House of Representatives, Washington, D.C.), p. 10.1-10.10.

Data requirements from the user's standpoint.

User needs in geology and cartography. W. A. Fischer (U.S. Geological Survey, Washington, D.C.), p. 11.1-11.24.

Oceanographic data requirements for the development of an operational satellite system. R. E. Stevenson (Bureau of Commercial Fisheries, Galveston, Tex.), p. 12.1-12.12.

User needs in agriculture and forestry. A. B. Park (U.S. Department of Agriculture, Washington, D.C.), p. 13.1-13.26.

Space acquired data - Hydrological requirements. P. Bock (Connecticut, University, Storrs, Conn.), p. 14.1-14.8.

The atmosphere as a resource. J. Smagorinsky (ESSA, Princeton, N.J.), p. 15.1.

The exploration of non-agricultural natural resources in developing countries by the United Nations. J. Barnea (United Nations, New York, N.Y.), p. 16.1-16.6.

Economic and international aspects.

Status and prospects of international earth resources satellite programs. A. W. Frutkin (NASA, Washington, D.C.), p. 17.1-17.9.

Estimating the economic benefit of surveying earth's resources. K. P. Heiss (Mathematica, Inc., Princeton, N.J.), p. 18.1-18.13.

A water management model using earth resources satellites. A. H. Muir (Earth Satellite Corp., Washington, D.C.), p. 19.1-19.15.

Agricultural resource information requirements of non-governmental users. H. G. Lorsch (General Electric Co., New York, N.Y.), p. 20.1-20.17.

Management of grazing lands by earth resources satellites. C. R. Frank (Princeton University, Princeton, N.J.), p. 21.1-21.6.

A70-39060

An earth resources satellite system in a political light. Joseph E. Karth (U.S. House of Representatives, Washington, D.C.). In: Princeton University, Conference on Aerospace Methods for Revealing and Evaluating Earth's Resources, Princeton University, Princeton, N.J., September 25, 26, 1969, Proceedings. Edited by J. P. Layton. Princeton, N.J., Princeton University Conference, 1970, p. 10.1-10.10.

Discussion of the political aspects involved in the space program giving particular attention to the political background of the Earth Resources Satellite. The U.S. Space Program in its political context is considered taking into consideration the history of this program and the political climate of today. It is recommended that NASA should emphasize those projects which hold promise for improving the quality of life on earth. The political history of the Earth Resources Satellite is discussed and international implications of an Earth Resources Satellite System are examined. G.R.

A70-39064 *

Status and prospects of international earth resources satellite programs. Arnold W. Frutkin (NASA, Washington, D.C.). In: Princeton University, Conference on Aerospace Methods for Revealing and Evaluating Earth's Resources, Princeton University, Princeton, N.J., September 25, 26, 1969, Proceedings.

Edited by J. P. Layton. Princeton, N.J., Princeton University Conference, 1970, p. 17.1-17.5; Discussion, p. 17.6-17.9.

Examination of ERTS A and B (Earth Resources Technology Satellites) with reference to their international utility, rather than as an engineer or a scientist might look at them. As a system, ERTS A is primarily a program directed to U.S. requirements, although other countries may be able to read out the data if they wish. ERTS A is the first major test for which preliminary information, data, and training are available. F.R.L.

A70-39065

Estimating the economic benefit of surveying earth's resources. Klaus P. Heiss (Mathematica, Inc., Princeton, N.J.). In: Princeton University, Conference on Aerospace Methods for Revealing and Evaluating Earth's Resources, Princeton University, Princeton, N.J., September 25, 26, 1969, Proceedings.

Edited by J. P. Layton. Princeton, N.J., Princeton University Conference, 1970, p. 18.1-18.13.

Discussion of the methods of cost-benefit analysis and of the application of these methods for a determination of the economic benefits of earth's resources surveys by satellite. Various charts and methods used in an analysis of economic benefits are considered, and the application of the rule of the maximization of absolute benefits to a new technological system is discussed. The expected benefits to be obtained by satellite surveys in the fields of U.S. agriculture, forestry, and mapping are investigated. G.R.

A70-39481

Skylab scheduled for 1972. Raymond N. Watts, Jr. (Smithsonian Astrophysical Observatory, Cambridge, Mass.). *Sky and Telescope*, vol. 40, Sept. 1970, p. 146-148.

Discussion of the design of the Skylab, a large scientific space station that will become a satellite of the earth late in 1972 and have a useful life of eight months. The space station will have living quarters and supplies for a three-man crew, an artificial atmosphere, and provision for attaching large experimental packages. These include a manned solar observatory with an array of eight instruments for X-ray, UV, and visible-light observations. Some earth resources experiments to be conducted are briefly considered and tests in a Skylab underwater simulator are discussed. G.R.

A70-39796

Securing international participation. John Hanessian, Jr. and John M. Logsdon (George Washington University, Washington, D.C.). *Astronautics and Aeronautics*, vol. 8, Aug. 1970, p. 56-63, 21 refs.

Discussion of the Earth Resources Technology Satellite (ERTS) program and problems in securing international participation taking into consideration UN involvement in outer space. The basic

objectives of the ERTS are examined, and aspects of international cooperation for this undertaking as invited by the General Assembly of the UN are discussed. An organization chart showing various agencies and councils of the UN connected with outer space affairs is presented. G.R.

A70-39944 Uses of space observations of the earth - The EROS program of the Department of the Interior. William A. Fischer (U.S. Geological Survey, Washington, D.C.). In: An interamerican approach for the seventies: Materials technology - I; Southwest Research Institute, Interamerican Conference on Materials Technology, 2nd, Mexico City, Mexico, August 24-27, 1970, Proceedings. Conference co-sponsored by the Colegio de Ingenieros Mecánicos y Electricistas. New York, American Society of Mechanical Engineers, 1970, p. 440-444.

Description of the earth resources observation satellite program and the organization responsible for acquiring, processing, utilizing, and disseminating remote-sensor data on the environment and earth resources. The users of the data, including scientists, resources managers, educators, policymakers, and resource producers, are identified. It is pointed out that their need for timely data varies as does their current capability to effectively use this new data. Steps that are being taken and that must still be taken to assure good use of the data at time of launch are discussed. Z.W.

A70-42500 Methods of orbital experiments synthesis. V. Gradedak (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.). *Raumfahrtforschung*, vol. 14, July-Aug. 1970, p. 157-165. 8 refs. Research sponsored by the McDonnell Douglas Astronautics Co.

Discussion of methods of orbital experiments synthesis as aids in selecting and structuring space program objectives from the many possible alternatives. Questions of methodology are discussed and illustrative examples are provided from the fields of astronomy, biology, and oceanography. It is shown that by considering theoretical relationships and their consequences in terms of experimental requirements, it is possible to systematically identify frontiers of research or application areas and to correlate major objectives with the problems of crucial interest and the required measurements. G.R.

A70-43627 # Goals for man in space. S. Fred Singer (U.S. Department of the Interior, Washington, D.C.). In: International Academy of Astronautics, Orbital International Laboratory and Space Sciences Conference, Cloudcroft, N. Mex., September 28-October 2, 1969, Proceedings. Edited by J. P. Stapp, H. J. von Beckh, J. N. Howard, and E. A. Steinhoff. Holloman AFB, N. Mex., AFMDC, Publishing Management Branch, 1970, p. 4-14.

Discussion of the need for a manned space program, and delineation of various types of goals for man in space which seem technically feasible and worthwhile. The limitations of machine-based exploration are outlined, and attention is given to manned orbiting astronomical observations, lunar base stations, biological satellites, and earth resources satellites. A tentative optimum form of program development is proposed. T.M.

A70-43632 # The role of the United Nations in fostering international cooperation for the benefit of non-space countries and in particular the developing countries. A. H. Abdel Ghani (United Nations, Outer Space Affairs Div., New York, N.Y.). In: International Academy of Astronautics, Orbital International Laboratory and Space Sciences Conference, Cloudcroft, N. Mex., September 28-October 2, 1969, Proceedings. Edited by J. P. Stapp, H. J. von Beckh, J. N. Howard, and E. A. Steinhoff. Holloman AFB, N. Mex., AFMDC, Publishing Management Branch, 1970, p. 138-152.

Discussion of UN endeavors at gaining benefits for underdeveloped countries and nations without space effort capabilities from existing and future international space programs. Attention is given to specific practical roles played by the UN and its specialized

agencies in two major space application areas of meteorology and space communications. The activities of the World Weather Watch and the International Telecommunications Union are surveyed, and some relevant U.S. programs are cited. A program is suggested which combines the utilization of national space systems and facilities with international control and coordination. Such a program is considered particularly useful in the area of earth resources where it would foster closer cooperation between countries exercising sovereignty over the resources and countries which have the necessary capabilities to develop these resources. T.M.

A70-43652 # The large earth orbital space station - Investment or folly. Robert B. Demoret and George W. Morgenthauer (Martin Marietta Corp., Denver, Colo.). In: International Academy of Astronautics, Orbital International Laboratory and Space Sciences Conference, Cloudcroft, N. Mex., September 28-October 2, 1969, Proceedings. Edited by J. P. Stapp, H. J. von Beckh, J. N. Howard, and E. A. Steinhoff. Holloman AFB, N. Mex., AFMDC, Publishing Management Branch, 1970, p. 424-446. 7 refs.

Assessment of the value of the realization of a large earth-orbiting exploratory station in terms of its usefulness for the future well-being of mankind. Over-population and abuse of the earth with associated food and water shortages, air and water pollution, land use, and mineral and petroleum reserves depletion are considered to be problems of staggering dimensions requiring immediate radical actions to avert an all-out disaster. It is contended that a large manned Earth Orbital Space Station (EOSS) could provide the basic facility for research and operations in the development of a basis for the management and control of vital resources on earth, possibly under auspices of the United Nations. V.Z.

A70-44634 # Man's environment from space. K. Ia. Kondratyev. *International Astronautical Federation, International Astronautical Congress, 21st, Konstanz, West Germany, Oct. 4-10, 1970, Paper*. 13 p.

Discussion of aspects of space investigations connected with the use of space technology for studying the planet earth. The advantages to be derived from the correct forecasting of the weather as well as droughts and floods, the development of ice conditions, air and water pollution, and mapping of inaccessible territories, are discussed. It is noted that all the forecasting problems can in principle be solved with the help of automatic satellites. However, the decisive factors for the success of such experiments are considerations which make necessary the participation of man and which will bring into space specialists in meteorology, oceanology, geology, geobotany, and other branches of science. The problems of surveying the earth from space are complicated and multi-purpose as to both observational methods and the application of the data obtained. The observational methods can be visual, photographic, spectrophotometric, and thermal, microwave, and radar surveying. Their application is even more multi-purpose: atmospheric physics and meteorology, oceanography and hydrology of land, geology and geomorphology, soil studies and phytogeography, as well as investigations of cultural, industrial, and agricultural landscape. M.M.

A70-44679 # Earth resources information systems using satellites, aircraft and ground teams - An opportunity for international cooperation. Philip G. Langley (Earth Satellite Corp., Berkeley, Calif.). *International Astronautical Federation, International Astronautical Congress, 21st, Konstanz, West Germany, Oct. 4-10, 1970, Paper*. 12 p.

Description of the combined use of space photography, aerial photography, and ground measurements for obtaining precise statistics about the earth resources. An IR color photograph of the Mississippi Valley taken by the Apollo 9 astronauts is examined. An aerial survey is described, involving multistage variable probability sampling in which the increasingly finer resolution of each stage of photography contributes information pertinent to the selection of the subsample at the following stage. The better the predictions at

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each sample stage, as to the relative amount of resource present in each population unit, the greater the precision and efficiency of the overall survey subject to certain restrictions which are not discussed.

Z.W.

A70-45005 Use factors influencing the design of multi-purpose earth resource satellites. W. A. Fischer (U.S. Geological Survey, Washington, D.C.). In: International Astronautical Federation, Congress, 19th, New York, N.Y., October 13-19, 1968, Proceedings. Volume 1 - Spacecraft systems. Edited by Michał Lunc. Oxford, Pergamon Press, Ltd.; Warsaw, Państwowe Wydawnictwo Naukowe, 1970, p. 135-138.

Analysis of resources problems that are believed to be susceptible to solution from space platforms, which suggests that many are unique in terms of the type(s) of data that are required for solution and the time(s) at which the data must be acquired. This analysis argues for the development of a series of small earth resources satellites, each dedicated to the solution of a particular problem or a group of problems.

F.R.L.

A70-45526 Dynamics of satellites; Proceedings of the Symposium, Prague, Czechoslovakia, May 20-24, 1969. Symposium sponsored by COSPAR, the International Astronomical Union, the International Association of Geodesy, and the International Union of Theoretical and Applied Mechanics. Edited by Bruno Morando (Bureau des Longitudes, Paris, France). Berlin, Springer-Verlag, 1970. 317 p. In English and French. \$23.10.

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Preface. B. Morando (Bureau des Longitudes, Paris, France), p. V.

Theory of the motion of an artificial satellite. B. Morando (Bureau des Longitudes, Paris, France), p. 1-6. 14 refs.

Advances in rapid orbit prediction and applications to satellite visibility studies. F. Morrison (U.S. Coast and Geodetic Survey, Rockville, Md.), p. 7-18. 14 refs.

Determination of the most probable elements of a satellite orbit from incomplete systems of elements. I. V. Batrakov (Akademiia Nauk SSSR, Institut Teoreticheskoi Astronomii, Leningrad, USSR), p. 19-23.

On the influence of distribution of observations on accuracy of orbital elements of the earth's artificial satellites. A. S. Sochilina (Akademiia Nauk SSSR, Institut Teoreticheskoi Astronomii, Leningrad, USSR), p. 24-27.

The use of ellipsoidal harmonics for the representation of the geopotential. H. G. Walter (ESRO, Darmstadt, West Germany), p. 28-35. 15 refs.

Computer derivation of short-period lunar perturbations. J. R. Cherniack and E. M. Gaposchkin (Smithsonian Astrophysical Observatory, Cambridge, Mass.), p. 36-39. 6 refs.

Second-order perturbations of an artificial earth satellite (Perturbations du second ordre d'un satellite artificiel de la terre). B. Morando, J. Chapront, and P. Bretagnon (Bureau des Longitudes, Paris, France), p. 40.

A short study on the motion of artificial satellites of Mercury and Venus. E. Buchar (České Vysoké Učení Technické, Prague, Czechoslovakia), p. 41.

Results on the mass and the gravitational field of the moon as determined from dynamics of lunar satellites. W. H. Michael, Jr., W. Th. Blackshear, and J. P. Gapcynski (NASA, Langley Research Center, Hampton, Va.), p. 42-56. 20 refs.

The use of Brown's lunar theory in lunar satellite perturbations by sun and earth. A. E. Roy (Glasgow, University, Glasgow, Scotland), p. 57-62. 8 refs.

The determination of planetary masses from radio tracking of space probes and planetary radar. W. G. Melbourne (California Institute of Technology, Pasadena, Calif.), p. 63-88. 49 refs.

Satellite trajectory determination and their expected errors - OGO-IV, GEOS-I. F. O. Vonbun (NASA, Goddard Space Flight Center, Greenbelt, Md.), p. 89-97. 15 refs.

Revised values for coefficients of zonal spherical harmonics in the geopotential. Y. Kozai (Tokyo Astronomical Observatory, Tokyo, Japan; Smithsonian Astrophysical Observatory, Cambridge, Mass.), p. 104-108.

Improved values for the tesseral harmonics of the geopotential and station coordinates. E. M. Gaposchkin (Smithsonian Astrophysical Observatory, Cambridge, Mass.), p. 109-118. 7 refs.

On the determination of parameters of the earth's figure from satellite orbit dynamics. M. Burša (Vězkumný Ústav Geodézie, Prague, Czechoslovakia), p. 119.

Accuracy of satellite orbits obtainable by synchronous satellite tracking. C. F. Martin (Wolf Research and Development Corp., Riverdale, Md.), p. 120-129.

Resonant satellite geodesy by high speed analysis of mean Kepler elements. C. A. Wagner (NASA, Goddard Space Flight Center, Greenbelt, Md.), p. 130-137. 17 refs.

Results of the analysis of laser measurements in semidynamic geodesy (Résultats du dépouillement des mesures laser en géodésie semi-dynamique). B. Lago (Centre National d'Etudes Spatiales, Brétigny-sur-Orge, Essonne, France), p. 138-146.

Short arc optical survey of the GEOS North American network. J. J. Lynn (DEA Systems, Inc., Melbourne, Fla.), p. 147-153. 5 refs.

Treatment of Doppler measurements in semidynamic geodesy (Traitement des mesures Doppler en géodésie semi-dynamique). J.-P. Chassaing (Centre National d'Etudes Spatiales, Brétigny-sur-Orge, Essonne, France), p. 154-161. 8 refs.

Comparative analysis of different results on the European datum from spatial geodesy. M. Lefebvre (Centre National d'Etudes Spatiales, Brétigny-sur-Orge, Essonne, France), p. 162-169. 7 refs.

Comparisons and combinations of geodetic parameters estimated from dynamic and geometric satellite solutions and from Mariner flights. K. Lambeck (Smithsonian Astrophysical Observatory, Cambridge, Mass.), p. 170-179. 5 refs.

Tidal potential with location-dependent amplitude and phase angle. W. M. Kaula (California, University, Los Angeles, Calif.), p. 180.

On the determination of field parameters using a generalized Fourier-analysis. M. Schneider and Ch. Reigber (München, Technische Hochschule, Munich, West Germany), p. 181-188. 7 refs.

Correlation between the solar activity indices and the use of these indices in the study of motion of the earth satellites. A. M. Fominov (Akademiia Nauk SSSR, Institut Teoreticheskoi Astronomii, Leningrad, USSR), p. 189-193. 6 refs.

New investigations of motion of an artificial satellite about its center of mass. V. V. Beletskii (Akademiia Nauk SSSR, Institut Prikladnoi Matematiki, Moscow, USSR), p. 194-206. 19 refs.

Dynamics of spin-stabilized flexible satellites of crossed-dipole configuration. F. R. Vigneron (Department of Communications, Ottawa, Canada), p. 207-215. 9 refs.

Comparison of air densities derived from the orbits of 1966-51A, B and C. D. G. King-Hele and D. W. Scott (Royal Aircraft Establishment, Farnborough, Hants., England), p. 216-229. 7 refs.

The use of AES orbits evolution data for refinement of some geophysical parameters. P. E. Eliasberg (Akademiia Nauk SSSR, Institut Kosmicheskikh Issledovani, Moscow, USSR), p. 230-243. 6 refs.

Analysis of the atmospheric drag of the Echo 1 satellite using the PERLO orbital period determination program. I. Almár, A. Horváth, and E. Illés (Konkoly Observatory, Budapest, Hungary), p. 244-248. 11 refs.

The upper atmosphere and its influence on satellite orbits. D. G. King-Hele (Royal Aircraft Establishment, Farnborough, Hants., England), p. 249-261. 25 refs.

Radiation pressure effects in the motion of artificial satellites. L. Sehnal (Československá Akademie Věd, Prague, Czechoslovakia), p. 262-272. 39 refs.

Air drag and solar radiation pressure effects on close earth satellites. L. Sehnal (Československá Akademie Věd, Ondřejov, Czechoslovakia) and E. M. Gaposhkin (Smithsonian Astrophysical Observatory, Cambridge, Mass.), p. 273.

Effects of the atmosphere and reflected radiation pressure at high altitudes (Effets de l'atmosphère et de la pression réémise à haute altitude). M. Rapoport, M. Rousseau (Bordeaux, Université, Observatoire, Floirac, Gironde, France), and Lauret (Meudon, Observatoire, Meudon, Hauts-de-Seine, France), p. 274-282.

The earth's shadowing effects in the short-periodic perturbations of satellite orbits. P. Lala and L. Sehnal (Československá Akademie Věd, Prague, Czechoslovakia), p. 283.

Earth-reflected radiation pressure. D. E. Smith (Wolf Research and Development Corp., Riverdale; NASA, Goddard Space Flight Center, Greenbelt, Md.), p. 284-294. 9 refs.

The orbital accelerations of high balloon satellites. K. Fea (London, University, Observatory, London, England), p. 295-302. 10 refs.

Earth albedo effects on the orbital variations of Echo I and PAGEOS I. E. J. Prior (NASA, Langley Research Center, Hampton, Va.), p. 303-312. 17 refs.

A70-45869 * The earth resources technology satellites (ERTS) system. W. E. Scull and T. M. Ragland (NASA, Goddard Space Flight Center, Greenbelt, Md.). *Society of Automotive Engineers, National Aeronautic and Space Engineering and Manufacturing Meeting, Los Angeles, Calif., Oct. 5-9, 1970, Paper 700761*. 4 p. Members, \$1.00; nonmembers, \$1.50.

Description of the Earth Resources Technology Satellites (ERTS) which are part of an experimental program to provide data pertaining to agriculture, geology, hydrology, geography, cartography, and oceanography. The primary objective of the ERTS mission is to obtain high-resolution multispectral images of the earth's surface over a period of one year. This program has already been implemented with the launch of ERTS-A scheduled for March 1972. O.H.

A71-11436 * # The Earth Resources Technology Satellites - ERTS-A and -B. Wilfred E. Scull (NASA, Goddard Space Flight Center, Greenbelt, Md.). *International Astronautical Federation, International Astronautical Congress, 21st, Konstanz, West Germany, Oct. 4-10, 1970, Paper*. 21 p.

Description of the objectives, basic requirements, and features of the Earth Resources Technology Satellites ERTS-A and -B. The primary objective of the ERTS missions, to obtain high resolution multispectral images of the earth's surface over a period of one year, is a compromise to meet requirements coordinated by four government agencies in several major areas of interest: agriculture and forestry and their resources; geology and mineral resources; hydrology and water resources; geography, cartography, and cultural resources; and oceanography and marine resources. M.M.

A71-12918 Evolution of space research toward applications (in France) (L'évolution de la recherche spatiale vers les applications /en France/). R. Aubinière (Centre National d'Études Spatiales, Paris, France). *L'Onde Electrique*, vol. 50, Nov. 1970, p. 831-837. In French.

Review of present and future space programs financed under various plans of the French government. Emphasis is placed on the useful applications of satellites launched and to be launched. Telecommunication applications are stressed in connection with the Symphonie satellite, meteorology in connection with Eole and

Météosat, and air navigation aids in connection with Dioscures. The forthcoming sixth plan of the French government, which also provides for applications in the fields of space geodesy and earth resources studies, is evaluated. A.B.K.

A71-14817 Space technology and earth problems; American Astronautical Society, Symposium, Las Cruces, N. Mex., October 23-25, 1969, Proceedings. Edited by C. Q. Ford (New Mexico, University, Las Cruces, N. Mex.). Tarzana, Calif., American Astronautical Society (AAS Science and Technology Series. Volume 23), 1970. 393 p. \$14.75.

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The systems challenge in transportation. J. E. Beggs (U.S. Department of Transportation, Washington, D.C.), p. 3-15.

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A progress report on the lifting body flight test program. M. O. Thompson (NASA, Washington, D.C.), p. 23-27.

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The impact of satellite monitoring on natural resource public policy issues. I. Clark, p. 39-46.

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Application of space technology to atmospheric pollution measurement. R. S. Wiltshire and W. H. Clohessy (Martin Marietta Corp., Denver, Colo.), p. 49-58.

Experiments in dynamical weather prediction. K. Miyakoda (Princeton University, Princeton, N.J.), p. 59-68.

Potential for application of earth-oriented satellites to air pollution. A. P. Altshuler and R. A. McCormick (U.S. Public Health Service, Washington, D.C.), p. 69-74.

The role of extraterrestrial surveillance in cloud and weather modification. C. L. Hosler (Pennsylvania State University, University Park, Pa.), p. 75-84.

The cold earth. W. L. Webb (U.S. Army, Electronics Command, White Sands Missile Range, N. Mex.), p. 85-96.

Electron density measurements in the upper atmosphere. J. Smith (Texas, University, El Paso, Tex.), p. 97.

The thermistor measurement of temperature in the 30-65 km atmospheric region. H. N. Ballard (U.S. Army, Atmospheric Sciences Laboratory, White Sands Missile Range, N. Mex.) and B. Rofe (Department of Supply, Salisbury, Australia), p. 98.

A cryogenic sampler for the determination of stratosphere composition. M. Izquierdo (Texas, University, El Paso, Tex.), H. Ballard (U.S. Army, Atmospheric Sciences Laboratory, White Sands Missile Range, N. Mex.), A. Haire (Petroff and Associates, Los Angeles, Calif.), and M. Thiel (Southern Missionary College, Collegedale, Tenn.), p. 99.

A parachute borne beta ray densitometer. J. A. Whitacre, M. Izquierdo (Texas, University, El Paso, Tex.), H. N. Ballard (U.S. Army, Atmospheric Sciences Office, White Sands Missile Range, N. Mex.), and B. Sellers, p. 100.

Faraday rotation system for measuring electron densities. R. Rubio (U.S. Army, Atmospheric Sciences Laboratory, White Sands Missile Range, N. Mex.), p. 101.

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A study of the prediction accuracies of several atmosphere models used on a medium altitude satellite. J. A. Ward, Jr. (RCA International Service Corp.), p. 102.

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Planning for integrated urban communications. J. O. Campbell (Campbell and Campbell, Scientists and Engineers, Los Angeles, Calif.), p. 105-112.

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Communication antennas for ocean based data acquisition system. J. R. Dearden (General Electric Co., King of Prussia, Pa.), p. 154.

Demand forecasting for information transfer satellites. R. W. Hough (Stanford Research Institute, Menlo Park, Calif.), p. 155.

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Potential benefits from remote sensing of agricultural, forest, and range resources. E. E. Hardy (Cornell University, Ithaca, N.Y.), p. 159-166.

The potential contribution of remote sensing to world food production. S. Baker (Florida Atlantic University, Boca Raton, Fla.), p. 167-175.

Systems planning - A spaceborne methodology for earth-bound problems. E. A. Gardner (Northrop Corp., Anaheim, Calif.), p. 177-191.

Earth resources satellites - Capabilities versus requirements. A. J. Stratton (NASA, Mission Analysis Div., Moffett Field, Calif.), p. 193-202.

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Analysis of data from remote sensing systems. R. F. Pascucci (Raytheon Co., Alexandria, Va.) and G. W. North (U.S. Geological Survey, Washington, D.C.), p. 206.

Land use mapping of the southwestern United States from satellite imagery. N. J. W. Thrower and L. W. Senger (California, University, Los Angeles, Calif.), p. 207.

Space systems for earth resources information. D. M. Waltz (TRW Systems Group, Redondo Beach, Calif.), p. 208.

Remote sensing - Sense or nonsense. R. C. Wilson, p. 209.

Oceans and water systems.

Man's progress into the sea. W. M. Nicholson (U.S. Navy, Washington, D.C.), p. 213-228.

Potential use of earth satellites for solving problems in oceanography and hydrology. E. P. McClain (ESSA, Washington, D.C.), p. 229-241.

Tidal basin resonance for power. M. H. Cobble (New Mexico State University, University Park, N. Mex.), p. 243-261.

A systems approach to water basin management planning. R. F. Jewett (TRW Systems Group, Redondo Beach, Calif.), p. 263.

Application of large scale computers to abatement of water pollution. J. M. Jeglic (Keystone Computer Associates, Inc., Fort Washington, Pa.) and G. D. Pence, Jr. (Federal Water Pollution Control Administration, Edison, N.J.), p. 264.

Ocean wave pneumatic attenuation systems. S. N. Sherk (General Electric Co., Philadelphia, Pa.), p. 265.

Unlimited water and power with solar energy energizing electronic, steam and turbines in systems. J. F. Crane (Life Laboratories, Inc., San Diego, Calif.), p. 266.

Application of an atmospheric model to the ocean environment. G. S. Ruggles (RCA Service Co., West Palm Beach, Fla.) and L. N. Walker (Georgia, University, Athens, Ga.), p. 267.

Underwater range tracking at Barking Sands Tactical Underwater Range, Hawaii. G. A. Nussear and P. Seelinger (U.S. Navy, Pacific Missile Range, Point Mugu, Calif.), p. 268.

Product assurance in oceanics - A natural outgrowth of the aerospace industry. E. R. Britton (General Electric Co., Philadelphia, Pa.), p. 269.

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Multisensor correlation technique applied to hydrology. J. M. Kennedy (Resources Technology Corp., Houston, Tex.), p. 315-327.

Simulating the consequence of cloud cover on earth-viewing space missions. S. C. Brown (NASA, Marshall Space Flight Center, Huntsville, Ala.), p. 329.

Precision pointing of a high gain antenna from a planetary lander. R. G. Brown (Martin Marietta Corp., Denver, Colo.), p. 330.

Space photographs of the earth in the study of geotectonics. E. Y. Kedar (NASA, Manned Spacecraft Center, Houston, Tex.), p. 331, 332.

A multiband photographic system. B. Chang (North American Rockwell Corp., Downey, Calif.), p. 333.

A tradeoff study in space geodesy altimetry. E. Weiss (Raytheon Co., Sudbury, Mass.), p. 334.

Precision and accuracy of test geometry. F. Hanson (U.S. Army, Electronics Command, White Sands Missile Range, N. Mex.), p. 335.

Transportation systems.

Aerospace research support of high speed tracked air cushion vehicle program. D. G. Stephens (NASA, Langley Research Center, Hampton, Va.), p. 339-353.

Lightweight expandable bridge. M. L. Clevett (Martin Marietta Corp., Denver, Colo.), p. 355-363.

Application of aerospace guidance and control concepts to high speed train transportation systems. S. A. Steele (General Electric Co., Valley Forge, Pa.), p. 365-374.

Optimum design of vehicular drive systems. L. P. Hajdu, J. Peschon, and P. Henault (Wolf Management Services, Palo Alto, Calif.), p. 375-388.

Horizontal elevator - New concept in rapid transit. E. O. Haltom (Varo, Inc., Garland, Tex.), p. 389-397.

City planning using an urban performance model. A. Brown (Planning Research Corp., Washington, D.C.), p. 399.

Truck vibrations - An old problem with a modern solution via computer. H. S. Walker and G. R. Potts (Kansas State University, Manhattan, Kan.), p. 400.

Space technology applications to highway safety. M. A. Wilson and John S. Youtcheff (General Electric Co., Philadelphia, Pa.), p. 401.

A71-14820 The impact of satellite monitoring on natural resource public policy issues. Ibrahim Clark. In: Space technology and earth problems; American Astronautical Society, Symposium, Las Cruces, N. Mex., October 23-25, 1969, Proceedings.

Edited by C. Q. Ford. Tarzana, Calif., American Astronautical Society (AAS Science and Technology Series, Volume 23), 1970, p. 39-46.

Discussion of some of the socioeconomic applications and implications of natural resource satellites. The natural resource and environmental monitoring satellite is urgently needed to meet global ecological and natural resource study needs. A strategy of action is proposed for speeding up the global dissemination of satellite information.

Z.W.

A71-14929 * # Space shuttle requirements, program plans and progress. Dale D. Myers (NASA, Washington, D.C.). *Aerospace Management*, vol. 5, no. 1, 1970, p. 29-35.

Visualization of space shuttle requirements and program planning in the 70s to materialize a low cost combination of a reusable transport vehicle with a permanent orbiting laboratory for scientific and technological work and earth resource surveys. The operational characteristics and the economic aspects of this system are discussed. The chronology of the contracts involved is outlined. A diagram of the shuttle management plan and specifications of a reusable shuttle vehicle are given.

V.Z.

A71-15276 Space sciences - Future applications for mankind; Vandenberg Scientific and Technical Societies Council, Western Space Congress, 1st, Santa Maria, Calif., October 27-29, 1970, Proceedings. Part 1. North Hollywood, Calif., Western Periodicals Co., 1970. 546 p. Price of two parts, \$50.

Contents:

Satellite ETV and developing nations - A cost benefit approach. P. R. Lever (IBM Federal Systems Center, Gaithersburg, Md.), p. 1-9.

Place of multi-disciplinary design courses in engineering education. J. Skadky, Jr. (U.S. Naval Academy, Annapolis, Md.), p. 10-18. 5 refs.

Instructional monographs for classroom and self-study use. K. A. McCollom and R. L. Overton (Oklahoma State University, Stillwater, Okla.), p. 19-29.

Space Base Biomedical Center. O. H. Minney (General Electric Co., Valley Forge, Pa.), p. 30-39. 9 refs.

Application of aerospace technology to medicine. F. T. Wooten (Research Triangle Institute, Research Triangle Park, N.C.), p. 40-45.

Computerized anatomical model man for analyses of radiation doses. P. G. Kase and L. M. Ryan (Martin Marietta Corp., Denver, Colo.), p. 46-65. 17 refs.

Space sickness - Its causes and possible prevention. R. Mayne (Arizona State University, Tempe, Ariz.), p. 66-92. 59 refs.

Space nuclear power developments in the 1960-1980 decades. A. B. Martin (North American Rockwell Corp., Canoga Park, Calif.), p. 93-104.

The zinc-air battery - A 'clean' power source for the automobile. J. V. Leonard (McDonnell Douglas Corp., St. Louis, Mo.) and H. A. Crosby (Missouri, University, Rolla, Mo.), p. 105-111.

A review of composite propulsion systems. W. J. Niemann (USAF, Space and Missile Test Center, Vandenberg AFB, Calif.), p. 112-117. 7 refs.

The biosatellite fuel cell/battery power system. A. C. Bruhin and C. W. Bennett (General Electric Co., Philadelphia, Pa.), p. 118-139.

An ideal unit for a modular inverter. M. A. Geyer and A. Kernick (Westinghouse Electric Corp., Lima, Ohio), p. 140-152. 11 refs.

From satellite to air pollution - A technology spin-off. R. L. Chuan (Atlantic Research Corp., Costa Mesa, Calif.), p. 153-161. 5 refs.

Space television with the SEC camera tube. F. L. Schaff (Westinghouse Defense and Space Center, Baltimore, Md.), p. 162-170. 8 refs.

Constraints on application of systems methodology to socioeconomic needs. V. L. Grose (Tustin Institute of Technology, Santa Barbara, Calif.), p. 171-195.

Converting and testing space system analysis and development methods for urban renewal and development applications. W. S. Ward, D. P. Grant, and J. E. Garrigan (California State Polytechnic College, San Luis Obispo, Calif.), p. 196-199.

Nimbus satellite views hydrologic conditions. G. Rabchevsky (Allied Research Associates, Inc., Lanham, Md.), p. 200-221. 53 refs.

Space age management - Contractor program management - Forecast for 1975. C. Cocke (Avco Corp., San Bernardino, Calif.), p. 222-249. 28 refs.

Ecology management, challenge for aerospace technology. C. N. Golub, p. 250-257.

Launch vehicle design integration. M. A. Krop (Lockheed Missiles and Space Co., Sunnyvale, Calif.), p. 258-270.

Aerospace systems project management using the critical path method (CPM) for planning and control. G. E. Kobelski (USAF, Space and Missile Test Center, Vandenberg AFB, Calif.), p. 271-278. 8 refs.

The demand for information transfer services in 1990. R. W. Hough (Lockheed Missiles and Space Co., Sunnyvale, Calif.) and W. C. Sedlacek (Stanford Research Institute, Menlo Park, Calif.), p. 279-288.

The data system environment simulator (DASYS). L. E. DeCuir and R. W. Garrett (System Development Corp., Santa Monica, Calif.), p. 289-296.

MITOL - A telemetry oriented compiler language. C. W. LeRoy (USAF, Space and Missile Test Center, Vandenberg AFB, Calif.) and L. B. Collins (System Development Corp., Santa Monica, Calif.), p. 297-305.

The earth-moon test range. R. C. Wigand (NASA, Goddard Space Flight Center, Greenbelt, Md.), p. 306-312.

A pilot study of non-destructive testing of thin-walled cylinders under axial compression. D. J. Tenerelli (Lockheed Missiles and Space Co., Sunnyvale, Calif.), p. 313-320. 8 refs.

Standardization and testing of instrumentation magnetic tape. D. A. Shuldt (Ampex Corp., Redwood City, Calif.), p. 321-331. 5 refs.

A self-contained underwater swimmer guidance system. D. G. Robertson (U.S. Navy, Naval Missile Center, Point Mugu, Calif.), p. 332-338.

Double-gimbaled reaction wheel control system. E. D. Scott (Lockheed Missiles and Space Co., Sunnyvale, Calif.), p. 339-351. 15 refs.

A decomposition method for the stability analysis of a spacecraft attitude control system. H. K. Ramapriyan (Honeywell, Inc., Minneapolis, Minn.) and F. N. Bailey (Minnesota, University, Minneapolis, Minn.), p. 352-360. 6 refs.

Inertial guidance for everyone. S. P. Altman (System Development Corp., Santa Monica, Calif.), p. 361-375. 12 refs.

Survey improvement using satellite data. N. Bush (Pan American World Airways, Inc., Patrick AFB, Fla.) and D. R. Pflingsten (RCA International Service Corp., Patrick AFB, Fla.), p. 376-390. 15 refs.

The location and orientation of lunar astronauts. S. B. Brodie and D. L. Lorenz (Martin Marietta Corp., Denver, Colo.), p. 391-402.

Rapid determination of geodetic position. E. J. Greeley (U.S. Naval Material Command, Naval Weapons Laboratory, Dahlgren, Va.), p. 403-405.

Intercomparisons of orbital solutions based upon optical and Doppler observations of the GEOS I and II satellites. J. G. Marsh, R. W. Agreen (NASA, Goddard Space Flight Center, Greenbelt, Md.), and B. C. Douglas (Wolf Research and Development Corp., Riverdale, Md.), p. 406-420. 7 refs.

The earth's gravitational environment at synchronous altitudes. C. A. Wagner (NASA, Goddard Space Flight Center, Greenbelt, Md.), p. 421-426. 21 refs.

Aerospace to hydrospace - Oceanic instrumentation and communications. C. E. Mortlock and H. Popper (General Electric Co., Philadelphia, Pa.), p. 427-450. 29 refs.

Satellites for meteorology. P. E. Romo (TRW Systems Group, Redondo Beach, Calif.), p. 451-467.

Comments on the geologic use of Nimbus I television photography. G. Rabchevsky (Allied Research Associates, Inc., Lanham, Md.), p. 468-482. 48 refs.

A method for determination of atmospheric refraction characteristics through use of navigational satellite data. R. W. Claassen (U.S. Navy, Operations Research Div., Point Mugu, Calif.), p. 483-491.

Large multimission satellites, or supplying the missing links. W. A. Koenig and J. F. Houle (Lockheed Missiles and Space Co., Sunnyvale, Calif.), p. 492-499.

Orbital tracking through synchronous spacecraft. J. L. Cooley (NASA, Goddard Space Flight Center, Greenbelt, Md.), p. 500-505. 5 refs.

Application of Minuteman technology to near earth space missions. G. W. Driggers and R. L. Robinson (USAF, Space and Missile Systems Organization, Norton AFB, Calif.), p. 506-524. 8 refs.

ITOS-1, earth-oriented satellite. W. J. Haneman (RCA, Princeton, N.J.), p. 525-532.

Future impact of space technology in the public sector. R. J. Philips (NASA, Technology Utilization Div., Washington, D.C.), p. 533-539. 19 refs.

A71-15315 * 1 Future impact of space technology in the public sector. Ronald J. Philips (NASA, Technology Utilization Div., Washington, D.C.). In: Space sciences - Future applications for mankind; Vandenberg Scientific and Technical Societies Council, Western Space Congress, 1st, Santa Maria, Calif., October 27-29, 1970, Proceedings. Part 1. North Hollywood, Calif., Western Periodicals Co., 1970, p. 533-539. 19 refs.

This presentation discusses some of the benefits, both 'direct' and 'derived' that result from aerospace developed technology and will focus on the methodology employed by NASA to channel this technological knowledge into the mainstream of the economy.

(Author)

A71-15348 International policy aspects of space applications programs in the 1970's. The case of earth resource surveys.

John Hanessian, Jr. and John M. Logsdon (George Washington University, Washington, D.C.). In: Space sciences - Future applications for mankind; Vandenberg Scientific and Technical Societies Council, Western Space Congress, 1st, Santa Maria, Calif., October 27-29, 1970, Proceedings. Part 2. North Hollywood, Calif., Western Periodicals Co., 1970, p. 1046-1052.

Discussion of international political, legal, economic, and management considerations as they relate to the earth resource survey (ERS) satellite program. A description of this program as currently planned by the United States is first presented. Some of the more pertinent policy questions related to space applications programs which must be decided during the 1970's are sketched and discussed. They include the question of 'intrusion' into territorial sovereignty; ownership of data secured from earth orbit and control over its dissemination; possible use of these data for economic or military exploitive purposes; determination of and successful use of appropriate mechanisms for the participation of developing countries in ERS programs; and reaching international agreement on the selection of the appropriate international management for an operational ERS program.

O.H.

A71-17050 * # The use of economic benefit analysis in earth resources satellite system planning. A. H. Muir (Planning Research Corp., Washington, D.C.) and R. A. Summers (NASA, Washington, D.C.). American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 5th, Philadelphia, Pa., Oct. 21-24, 1968, Paper 68-1077. 18 p. Contract No. NASw-1604.

The improved technique for planning research and development in earth resources satellite systems described here is based on the case study approach whereby a number of specific conceptual satellite-assisted information systems are projected for an operational time frame. Economic impact analyses are performed for these technically feasible, user-responsive systems (e.g., in agriculture and hydrology), so that economically promising systems can be separated from nonpromising ones. Parametric data are collected from these conceptual system designs for such subsystems as sensors, data processing, attitude control and telemetry. By means of a 'sufficient' number of case studies, a probable 'technology/system scenario' for future space applications can be described. A distillation of parametric requirements from these cases provides a functional set of applied research goals or guidelines. These requirements must then be evaluated in the light of current status and trends in technology and subsystem development.

(Author)

A71-19088 * # Skylab. R. Walter Cunningham (NASA, Manned Spacecraft Center, Houston, Tex.). (Society of Experimental Test Pilots, Symposium, 14th, Beverly Hills, Calif., Sept. 24-26, 1970.) Society of Experimental Test Pilots, Technical Review, vol. 10, no. 2, 1970, p. 139-156.

Description of the equipment, experiments, and objectives of the Skylab Program. Spacecraft equipment is based on the Saturn V Workshop, consisting of four principal pieces of hardware: the Multiple Docking Adapter, the Airlock Module, the Orbital Workshop, and the Apollo Telescope Mount. Skylab is intended to provide 420 man-days of orbital operations, and present planning envisions 15 medical experiments, 21 science and technology experiments, five earth resources experiments, nine engineering experiments, and three DOD experiments. Some operational features of Skylab missions are described.

T.M.

A71-24171 * # The earth resources survey program jells. Leonard Jaffe and Robert A. Summers (NASA, Office of Space Science and Applications, Washington, D.C.). *Astronautics and Aeronautics*, vol. 9, Apr. 1971, p. 24-40. 25 refs.

The NASA ERS and R&D are discussed as a basis for a future operational earth-survey system combining spacecraft, aircraft and ground observations. The topics include the Earth Resources Aircraft Program which operates three aircraft and is the source of most data available to date; the Earth Resources Technology Satellites A and B planned for launch in 1972; and an operational ERTS system model

of the future, linking natural phenomena, earth conditions, remote sensing data, physical status predictions and management actions into a single system. V.Z.

A71-24172 * # ERTS A and B - The engineering system. Theodore A. George (NASA, Office of Space Science and Applications, Washington, D.C.). *Astronautics and Aeronautics*, vol. 9, Apr. 1971, p. 41-51.

The engineering aspects of the A and B experimental space missions for the interpretation and utilization of earth-resources survey data from space are discussed. The topics include the Nimbus design of the two satellite structures, the satellite communications and data-handling subsystems with dual telemetric, tracking and command equipment, the altitude, thermal control, orbit-adjust electrical-integration and image-processing subsystems, the payload, and aerospace ground equipment. It is expected that the next generation of earth-resources-survey spacecraft will be on a much higher level of sophistication than the present designs while retaining roughly the same weights and sizes. V.Z.

A71-26526 Engineering for the space environment; American Society of Civil Engineers and American Institute of Aeronautics and Astronautics, Specialty Conference, Houston, Tex., April 15-17, 1970, Proceedings. New York, American Society of Civil Engineers, 1970. 183 p. \$6.00.

Engineering problems involving lunar exploration vehicles, space shuttle, lunar topology and exploration, earth's resource assessment, and monitoring of the world ocean environment. The civil engineering activity in the aerospace programs is reviewed in terms of developments of lunar roving and ground-effects vehicles, special remote sensors and photographic techniques for assessing earth's food, minerals, and water resources, and space shuttle and space tug projects. Z.W.

A71-32689 # Spatial activities in France (Les activités spatiales en France). André Lebeau (Centre National d'Etudes Spatiales, Paris, France). *L'Aéronautique et l'Astronautique*, no. 28, 1971, p. 15-24. In French.

Review of French space activities, describing their development from the beginning, with emphasis on their compatibility with European and international programs. The basic objective of the French program is to bring Europe to a state of autonomy in all main application areas. The application program is based on working agreements with all interested services: telecommunications, meteorology, data collection, natural resources, and air/sea traffic control. The main lines of advanced research and development for launchers, sounding rockets, and balloons are outlined. F.R.L.

A71-32854 The ERTS programme and international co-operation. N. Simmons. *Deutsche Gesellschaft für Luft- und Raumfahrt, British Interplanetary Society, Société Française d'Astronautique, and Associazione Italiana di Aerotecnica, European Space Symposium, 11th, Berlin, West Germany, May 24-26, 1971, Paper.* 14 p.

The general concept of the NASA Earth Resources Technology Satellites (ERTS) system devoted specifically to earth resources remote sensing technology is outlined. The features of the ERTS A and B satellites now under development for launch in March 1972 and 1973, respectively, their payloads, and also those of the ground system, are described. International aspects of the ERTS program are discussed. O.H.

A71-33589 Some economic speculations on space applications to world needs. D. Kybal (Lockheed Missiles and Space Co., Sunnyvale, Calif.). In: Organizing space activities for world needs, International Academy of Astronautics, International Astronautical Congress, 19th, New York, N.Y., October 13-19, 1968, Proceedings.

Edited by E. A. Steinhoff. Oxford, Pergamon Press, Ltd., 1971, p. 447-458. 13 refs.

The world food situation is analyzed. It is found that present low consumption rates in the developing countries together with excessive population growth make a significant increase in food production mandatory. The potential contribution that advanced technology can make to increase the information flow essential to the agriculturist for such a rise in food production is considered. This potential contribution will be made primarily in the area of earth-oriented satellites, sensors, computers, and electronic displays. Space applications may well provide the leverage for major agricultural production improvements as well as for the associated need for farm education. G.R.

A71-33826 # Activities in earth remote sensing surveys in Brazil. Fernando de Mendonça (Instituto de Pesquisas Espaciais, São José dos Campos, São Paulo, Brazil). *COSPAR, Plenary Meeting, 14th, Seattle, Wash., June 18-July 2, 1971, Paper.* 15 p.

This report presents a brief description of the Brazilian remote sensing program including the different phases covered so far and the steps to be taken during the next couple of years. The emphasis is put on the organization of the program and the preliminary results rather than on the instrumentation. One of the short range objectives is to have our full system in a position to efficiently use the data to be acquired starting next year by the NASA Environmental Resources Technology Satellites. (Author)

A71-33858 # Space research in the Netherlands. COSPAR, Plenary Meeting, 14th, Seattle, Wash., June 18-July 2, 1971, Paper. 22 p. 48 refs.

Review of the 1970 space research organization, projects, activities, major participants, and publications in the Netherlands. Coordination and stimulation of geophysical and space research in the Netherlands is the task of the Netherlands Committee for Geophysics and Space Research. The Committee's functions are implemented by five working groups who are in charge of solar and stellar space research, satellite geodesy, photometry, cosmic radiation research, and the National Aerospace Laboratory. M.V.E.

A71-33861 French space program - Report to COSPAR World Committee of Space Research (Programme spatial français - Rapport au COSPAR Comité Mondial de la Recherche Spatiale). *COSPAR, Plenary Meeting, 14th, Seattle, Wash., June 18-July 2, 1971, Paper.* 98 p. 267 refs. In French.

Review of the French space program which covers seven different fields. These are: (1) physics of the ionosphere and the magnetosphere, (2) aeronomy and meteorology, (3) physics of particles and cosmic rays, (4) astronomy and astrophysics, (5) trajectory and geodesy, (6) biology, and (7) terrestrial resources. The programs described were carried out by CNRS, CNET, CESR, ONERA, and various universities, observatories, and laboratories. Two appendixes give particulars of French scientific satellites in orbit and of rocket probes launched by CNES. F.R.L.

A71-35329 The ERTS programme and international co-operation. N. Simmons (Ministry of Defence /Aviation Supply/, London, England). *(British Interplanetary Society, Symposium on Applications Satellites, University of Southampton, Southampton, England, Apr. 14, 15, 1971.) British Interplanetary Society, Journal,* vol. 24, Aug. 1971, p. 433-441.

The NASA Earth Resources Technology Satellites (ERTS) A and B are now under development for launch in March 1972 and late 1973, respectively. The satellite technique is intended to supplement rather than entirely replace the use of aircraft and also to promote the automatic data-processing of the great quantity of results obtained. The system concept is considered, and the sensing ranges of ERTS A/B and some applications are reported. The satellite is compatible as regards telemetry, tracking, and command both with STADAN and APOLLO ground stations. The participation of other countries in the ERTS program is discussed. G.R.

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A71-36442 Technology today and tomorrow; Canaveral Council of Technical Societies, Space Congress, 8th, Cocoa Beach, Fla., April 19-23, 1971, Proceedings. Volumes 1 & 2. Edited by N. A. Stein (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.). Cape Canaveral, Canaveral Council of Technical Societies, 1971. Vol. 1, 655 p.; vol. 2, 187 p.

Space communications, space logistics, launch facilities and operations, computer applications, simulation and synthesis, and cryogenics are among the space technology areas covered in the papers presented. Outlooks in advanced space programs, meteorology and weather control progress, management problems and solutions, and maintainability and reliability are reported in contributions pertaining to some of the other space activity aspects considered.

M.V.E.

A71-36753 Spatial activities in France. II (Les activités spatiales en France. II). André Lebeau (Centre National d'Etudes Spatiales, Paris, France). *L'Aéronautique et l'Astronautique*, no. 29, 1971, p. 17-23. In French.

Beginning with the first sketchy space programme, this paper correlates French developments with all other European and International activities. Essentially, French spatial work purposes to make Europe autonomous in all great application domains. Such an aim is not nationally restricted. The practical priority is not exclusive; well balanced adjustment is desired with Fundamental Research and Advanced Engineering Development. The practical Appliance Programme is systematically based on working agreements with all interested services. Programme content covers five descriptive chapters: telecommunication, meteorology, data collecting, natural resources, air and sea traffic control. The same paper shows the presently main lines of advanced Research and Development for launchers, sounding rockets and balloons. Well connected with its international background, the national French programme has grown able to attempt operational applications. (Author)

A71-37329 # Systems planning and operation of European application satellites. G. K. C. Pardoe (Hawker Siddeley Dynamics, Ltd., Stevenage, Herts., England). In: Prospects in the next decade for the use of orbiting stations and space shuttles; Technical and Scientific International Space Convention, 11th, Rome, Italy, April 1-3, 1971, Proceedings, Appendix (Prospettive nel prossimo decennio per la utilizzazione delle stazioni orbitali e delle navette spaziali; Convegno Internazionale Tecnico-Scientifico sullo Spazio, 11th, Rome, Italy, April 1-3, 1971, Atti, Appendice). Convention sponsored by the Ministero degli Affari Esteri and the Associazione Industrie Aerospaziali. Rome, Rassegna Internazionale Elettronica Nucleare e Teleradiocinematografica, 1971, p. 47-54.

Exposition of the view, with reference to communications satellites, that the countries of Europe, through their organizations, should strive to make maximum advantage from the experimental and early preoperational experience that will be coming from the SIRIO and Symphonie programs. They should also direct that the requirements for the mid-'70 satellites be as operational as possible. Attention is also given to European activities in aeronautical, meteorological, and earth resources satellites. Some aspects of the problems of the post-Apollo period are discussed. F.R.L.

A71-38148 Salyut. Kenneth W. Gatland. *Spaceflight*, vol. 13, Sept. 1971, p. 338-340.

Description of the Salyut space station and its operation. Salyut is an experimental flight vehicle, the purpose of which is to check basic systems and equipment. In addition it has the task of carrying out scientific experiments in the interests of the economy and to enhance knowledge of astrophysics. It is also concerned with mastering the practice of operating various equipment for spaceships, systems, and stations for the future. The docking and undocking procedures for the Soiuz 11 supply craft are described. F.R.L.

A71-39665 # Use of space television and photo images for earth sciences. B. V. Vinogradov (Leningradskii Gosudarstvennyi

Universitet, Leningrad, USSR). In: Space research XI; COSPAR, Plenary Meeting, 13th, and Symposium on Remote Sounding of the Atmosphere, Leningrad, USSR, May 20-29, 1970, Proceedings. Volume 1. Meeting and Symposium co-sponsored by the International Union of Geodesy and Geophysics and the World Meteorological Organization. Edited by K. Ia. Kondrat'ev, M. J. Rycroft, and C. Sagan. Berlin, East Germany, Akademie-Verlag, 1971, p. 525-532. 24 refs.

Discussion of some of the space methods of global, regional, and local earth imagery used in earth science studies. The emphasis lies on the most informative recording methods - i.e., photography, television, and spectrophotometry. Studies of the structure of natural complexes, interrelations of natural phenomena, and natural environment dynamics are briefly reviewed. M.V.E.

A71-40263 # Remote sensing research a major tool. Robert H. Miller (U.S. Department of Agriculture, Agricultural Research Service, Washington, D.C.). *Challenge*, vol. 10, Summer 1971, p. 8, 9.

Discussion of the potential capabilities and benefits of remote sensing, and review of some of the prerequisites to a fully operational remote sensing aerospace system for U.S. agriculture. Soil mapping and classification, forest fire reconnaissance, resource damage appraisal, inventory and productivity evaluation, assessment of environmental and ecological conditions, and study of man-environment interactions are among the topics briefly reviewed. M.V.E.

A71-40473 Communication satellites for the 70's: Systems. Edited by N. E. Feldman (RAND Corp., Santa Monica, Calif.) and C. M. Kelly (Aerospace Corp., El Segundo, Calif.). Cambridge, Mass., MIT Press (Progress in Astronautics and Aeronautics. Volume 26), 1971. 658 p. \$18.50.

A wide array of specific operational, experimental, and proposed satellite systems is covered in a manner providing a thorough overview of international research in the field of communications satellites. General areas considered include U.S. domestic systems, aeronautical service systems, communication and data collection problems of earth resources satellites, the concept and performance of various defense systems, the Canadian domestic satellite communications system, European projects, systems for emerging nations, advanced concepts and experiments (such as the measurement of precipitation scatter effects and cloud attenuation), systems engineering topics, and management of the frequency spectrum for space and orbit utilization. The relative merits of three-axis and dual-spin stabilization systems for future synchronous communications satellites are evaluated.

T.M.

A71-40910 # Earth Resources Survey Satellites. R. Tessier (ESRO, Paris, France). *Ruimtevaart*, vol. 20, Aug. 1971, p. 66-75.

Discussion of Earth Resources Survey Satellites (ERSS), which are orbiting platforms for the remote acquisition of agricultural, geographical, geological, and oceanographic data, etc., and the interrogation of in situ sensors recording similar data. Following an outline of basic principles the more important sensors are considered. These are metric, multispectral, and TV cameras, microwave and infrared radiometers, and spectrometers. Side-looking radar (SLAR) techniques are useful. Particulars of space applications and space technology are considered. F.R.L.

A71-41950 # Skylab - A manned scientific space laboratory. Leland F. Belew (NASA, Marshall Space Flight Center, Huntsville, Ala.). *International Astronautical Federation, International Astronautical Congress, 22nd, Brussels, Belgium, Sept. 20-25, 1971, Paper*. 63 p.

The general arrangement and some of the major features and accommodations of Skylab are discussed. The unmanned Skylab will be inserted into a near-circular 235 n mi (434.75 km) orbit with a nominal orbit inclination of 50 deg. One day later, a Command and Service Module with a three-man crew will be inserted into an

interim orbit and will rendezvous with Skylab. This crew will complete activation of Skylab for habitation, will conduct an experimental program, and prepare Skylab for orbital unmanned operation, after the Command and Service module has deorbited on the 28th day. A second Command and Service Module and crew will rendezvous with Skylab on the 90th day after the launch of the first Module. The crew will conduct experiments (mainly solar astronomy and earth resources experiment) for a period of up to 56 days. Ninety days after the launch of Module 2, a third Command and Service Module and crew will be launched to complete the experimental program. The experimental program and facilities for scientific exploration are discussed. The more than fifty scientific and engineering experiments include medical experiments, solar astronomy experiments, earth resources experiments, and engineering, technology, operations, and miscellaneous science experiments. V.P.

A71-41961 # Global monitoring and remote sensing from satellites. Bengt Lundholm (Swedish Natural Science Research Council, Stockholm, Sweden). *International Astronautical Federation, International Astronautical Congress, 22nd, Brussels, Belgium, Sept. 20-25, 1971, Paper. 13 p.*

Measurements of time- and space-variable environmental characteristics by spacecraft remote sensing on a global scale are discussed. Emphasis is made on studying secular processes and on grouping these variables into physicochemical or abiotic and biological variables. A high degree of geographical coverage, continuous and repeated, is noted as the great advantage of environmental satellite applications. Changes in the atmosphere, in the water bodies, and in the continents are noted as factors influencing remote sensing of geographical features. It is felt that satellite telemetry is a promising technique of global environmental monitoring. V.Z.

A71-41973 # Some immediate operational applications of satellite observations for a better management of several earth-resources. Nicholas L. Rosner. *International Astronautical Federation, International Astronautical Congress, 22nd, Brussels, Belgium, Sept. 20-25, 1971, Paper. 20 p. 12 refs.*

Consideration of some pioneering applications of ground-based remote-sensing techniques to the management of earth resources. An operational ground-based system of remote sensors and information-extraction techniques, developed and utilized in Central Europe, for remotely controlling open-air drying of forest products is described, as well as some extensions of this system in the fields of agriculture, hydrology, and meteorology. The prevailing and sufficient similarities of these early R & D program objectives to those of the more far-reaching ERSP (Earth Resources Survey Program) observations are demonstrated, as well as the proven utility and economy of the derived operative methods, thus suggesting their adaptability in the experimental phase of the ERSP as its tentative but immediate operative application. A.B.K.

A71-41974 # Planning of an operational earth exploration satellite service. Subrata K. Sarkar (Swiss Post, Telephone and Telegraph, Berne, Switzerland). *International Astronautical Federation, International Astronautical Congress, 22nd, Brussels, Belgium, Sept. 20-25, 1971, Paper. 14 p.*

Review of a recent agreement reached by the member countries of the International Telecommunication Union, laying down the basic radio regulations of a space system officially designated as Earth Exploration Satellite Service. A number of partial or complete revisions of relevant parts of the Radio Regulations of 1959 (revised in 1968) are presented, coordination procedures to be applied in appropriate cases are outlined, and a procedure for notification of frequency assignments is described. A.B.K.

A71-42526 # Our R & D economics and the Space Shuttle. Klaus P. Heiss (Mathematica, Princeton, N.J.). *Astronautics and Aeronautics*, vol. 9, Oct. 1971, p. 50-62.

It is shown how economic analysis should affect choice among competing R & D projects and how, in turn, a choice relates to the

national economy, the available resources, and the long-term outlook of the nation. Some ideas are offered to the technical community on how to approach, in the language of the economist, the problems of systems choice and, where possible, how to quantify the effects of particular proposed R & D programs. It is shown that the Space Shuttle System (SSS) could not be justified if reductions in launch costs only are taken into account. The nonrecurring cost associated with development and acquisition of the SSS is justified to a major extent by its effects on total space program costs. G.R.

A71-42979 * # Accommodation of astronomy and earth observations by Space Shuttle orbital sortie missions. David E. Davin (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.). *American Astronautical Society and American Institute of Aeronautics and Astronautics, Astrodynamics Specialists Conference, Ft. Lauderdale, Fla., Aug. 17-19, 1971, AAS Paper 71-303. 40 p. 14 refs. Contract No. NAS 8-26790.*

This paper presents the results of a basic orbital analysis effort to determine acceptable orbital regimes for accommodating both astronomy and earth observations by Space Shuttle orbital sortie missions. The requirements for each of these two general types of observations are defined, compared with the Shuttle's capability, grouped together when cooperative, and separated when conflicting. Optimum orbital conditions (altitude and inclination) for satisfying these requirements are specified, and preferred candidate launch times and dates are defined for specific orbital durations. The present nominal Space Shuttle mission will not exceed seven days in duration. This yields a range of from one to six days available for on-orbit operations. Missions up to 30 days can also be considered, with the additional requirements satisfied by modifications to the Manned Support Module or Shuttle as appropriate. The timing of the orbital initiation is determined by considering time over the U.S. illuminated at various sun elevation angles and by considering the occultations of the sun and earth to evaluate which astronomical targets are visible and should be grouped for targeting. Observation opportunities for astronomy and earth resources based on typical sensor limitations are evaluated to establish a set of candidate Shuttle sortie missions. The statistical distribution of world-wide cloud cover is then applied to obtain an estimate of sensor use rate for earth observations. (Author)

A71-43025 * # Swathing patterns of earth-sensing satellites and their control by orbit selection and modification. Joseph C. King (NASA, Goddard Space Flight Center, Greenbelt, Md.). *American Astronautical Society and American Institute of Aeronautics and Astronautics, Astrodynamics Specialists Conference, Ft. Lauderdale, Fla., Aug. 17-19, 1971, AAS Paper 71-353. 40 p.*

A generalized investigation of the swathing patterns produced by earth observation satellites in circular, sun-synchronous orbits reveals an extensive array of orbits with interesting and varied pattern-generating properties. The study focuses on repeating-type patterns, which occur well-distributed over the useful range of orbital altitudes and repeat cycle periods, and in particular on 'minimum-drift' repeating patterns. The latter are regularly distributed around a series of zero-drift altitudes and are advantageous because of their uniform swath progressions and one-day intervals between adjacent swaths. A major choice or compromise in pattern selection is between extent of geographic coverage (about 5 to 100%) and frequency of reobservation of covered areas (1 to about 20 days). It is feasible, however, to modify the swathing patterns of operating satellites by altering their orbits, with a propellant budget probably not exceeding a few percent of the spacecraft weight. (Author)

A71-44598 # What is a balanced space program for the 70's and beyond. Ronald J. Massa (Avco Corp., Wilmington, Mass.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 8th, Washington, D.C., Oct. 25-28, 1971, Paper 71-1020. 14 p. Members, \$1.50; nonmembers, \$2.00.*

The historical accomplishments of the national space program, through the 50's and 60's are briefly stated to the end of providing a

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context for the development of a balanced space program for the 70's. In recent years, without a strongly stated and widely accepted national space goal and amidst searching questions about the relevance of space exploration to contemporary social objectives and readily apparent human needs, the issue of a balanced space program has been raised primarily to assure that the scientific and applications promise of lower cost unmanned space technology not be sacrificed to begin new and more expensive manned programs. The factors which relate to balance and relevance are cited, and possible roles for manned and unmanned exploration of space, private ventures in space, and international cooperation and competition are described. The relation of all these factors to the national space budget is explored. M.V.E.

A71-44599 # Science in space: How pure - How pragmatic. Carl L. Kober (Martin Marietta Corp., Denver, Colo.). *American Institute of Aeronautics and Astronautics, Annual Meeting and Technical Display, 8th, Washington, D.C., Oct. 25-28, 1971, Paper 71-1021.* 6 p. 17 refs. Members, \$1.50; nonmembers, \$2.00.

Review of the reorientation problems that, with the end of the Apollo program, NASA is now confronted with. The problems of this science-to-applications transition are manifold: pure science in space is better defined than the new pragmatic applications. Other government agencies, such as the Department of the Interior, Department of State, Department of Agriculture, and Department of Commerce, are beginning to play a program role. Pragmatism in space science ranges from communications, air traffic control, education, to earth resources and meteorology. This creates for science in space an interagency problem. The problems of planning the next ten years of science in space under the aspects of proliferation and interaction of various government agencies raise questions on budget, cognizance, and program management. The policy problems to be resolved to arrive at a long-range space science program are defined. M.V.E.

A71-44867 # Making decisions for earth observation systems. R. A. Passman and R. J. Kirby (General Electric Co., Space Div., Philadelphia, Pa.). *International Astronautical Federation, International Astronautical Congress, 22nd, Brussels, Belgium, Sept. 20-25, 1971, Paper.* 9 p.

There are four key elements which must be confronted in order to make wise system design decisions. These elements include the need for data determined by those who would use it, technology readiness and availability for information gathering and data optimization, the role of man in earth resources programs in space, and the availability of scheduled boosters which satisfy requirements of volume and weight. There are many earth observation programs already underway. It is pointed out that the opportunities presented by planned flights must be taken into consideration when planning a space program schedule. G.R.

A72-10926 Astronautical research 1970; International Astronautical Federation, Congress, 21st, Konstanz, West Germany, October 4-10, 1970, Proceedings. Edited by L. G. Napolitano (Napoli, Università, Naples, Italy), P. Contensou, and W. F. Hilton. Amsterdam, North-Holland Publishing Co., 1971. 1097 p. In English and French. \$50.

Research reports on theoretical problems in astronautics, engineering and management aspects of space technology, and the utilization and applications of spacecraft. Topics considered include spacecraft dynamics, reentry physics, planetary physics and chemistry, bioastronautics, space-shuttle and space-station design, propulsion systems and materials, navigation and guidance problems, sensor technology, on-board data management, flight program management, earth resources satellites, scientific experiment spacecraft, meteorological satellites, and uses of satellites in the field of education. T.M.

A72-10949 * NASA earth resources satellite research and development program. L. Jaffe (NASA, Washington, D.C.). In:

Astronautical research 1970; International Astronautical Federation, Congress, 21st, Konstanz, West Germany, October 4-10, 1970, Proceedings.) Amsterdam, North-Holland Publishing Co., 1971, p. 785-818.

The NASA Earth Resources Survey (ERS) Program is discussed as an effort to augment the presently used ground techniques and limited aerial photography for obtaining larger survey data. The topics include the scientific and technological aspects of remote earth resources sensing, the past and present activities in this field, the immediate plans for the implementation of the program, and a summary of current and future international participation in it. The effective target areas of space observations under the program are listed as synoptic surveys, agriculture and forestry, geography, geology and mineral resources, hydrology and water resources, and marine resources. Acquisition of near real-time information, reduced data acquisition time, repeated coverage, measurement uniformity, global surveys without large on-site support requirements are indicated as the advantages of space observations. V.Z.

A72-10950 Earth resources information systems using satellites, aircraft and ground teams - An opportunity for international cooperation. P. G. Langley (Earth Satellite Corp., Berkeley, Calif.). In: *Astronautical research 1970; International Astronautical Federation, Congress, 21st, Konstanz, West Germany, October 4-10, 1970, Proceedings.*) Amsterdam, North-Holland Publishing Co., 1971, p. 819-828.

General consideration of various aspects of earth resources prospecting by satellites, aircraft and ground teams as a possible basis for productive international cooperation. Some representative satellite and aerial IR photographs of various terrains are given to demonstrate the possibilities of these techniques. Special attention is given to forest resources prospecting, in particular to timber inventory. V.Z.

A72-10952 The systems approach to the application of space technology. G. G. E. Lewis (British Aircraft Corp., Bristol, England). In: *Astronautical research 1970; International Astronautical Federation, Congress, 21st, Konstanz, West Germany, October 4-10, 1970, Proceedings.* Amsterdam, North-Holland Publishing Co., 1971, p. 855-858.

A definition of the systems approach concept and an elucidation of its use in space project engineering processes are attempted. Its main function is shown to consist in helping to arrive at the quickest and cheapest method of acquiring new knowledge relevant to space technology applications. M.V.E.

A72-11855 * # Training and education requirements for the practical application of remote sensing. R. A. Summers (NASA, Washington, D.C.). In: *International Symposium on Remote Sensing of Environment, 7th, University of Michigan, Ann Arbor, Mich., May 17-21, 1971, Proceedings. Volume 3.* Ann Arbor, University of Michigan, 1971, p. 1577-1585.

Review and analysis of the training and education needs of the Earth Resources Survey (ERS) program both within NASA and outside (i.e., domestic and foreign users). Potential recipients of training are identified, as well as categories of knowledge needs. The relationships between trainee categories and knowledge needs and between trainee categories and training mechanisms are explored. Some consideration is given to problems of training for the effective utilization of remote sensing in developing countries. M.V.E.

A72-12386 WARC 1971 - Scientific aspects. J. P. Hagen (Pennsylvania State University, University Park, Pa.). In: *EASCON '71; Electronics and Aerospace Systems Convention, Washington, D.C., October 6-8, 1971, Record.* New York, Institute of Electrical and Electronics Engineers, Inc., 1971, p. 128-136.

The new frequency allocations are discussed that were made at the 1971 World Administrative Radio Conference (WARC) for the scientific services of space research, radio astronomy, standard frequency and time signals, and earth resources exploration. In

addition, certain aspects of the work of the Technical Committee, such as studies of allowable power flux density and emitted power as they affect sharing, are also reviewed. The major accomplishment of the WARC is shown to be the opening of the allocated spectrum above 40 GHz. Space research, earth exploration, and radio astronomy have needs for frequency space both in the more or less transparent 'windows' and in the regions of strong absorption. On the whole, these needs were satisfied. M.V.E.

A72-15073 Regional and domestic satellite communication - Their future role and new applications. J. M. Brown (RAF, London, England). *Point-to-Point Communication*, vol. 16, Jan. 1972, p. 27-35.

Current developments in satellite communications are reviewed with special attention to Intelsat IV, pointing out that the higher radiated power and greater stability of the satellite have made possible the introduction of spotbeams and simpler ground stations. It is also indicated that this satellite design has enabled regional and domestic systems to be planned for Canada, USA and Europe and has made educational systems a possibility for Brazil and India. The review also covers earth resources satellites, geological feature surveys, and environmental and maritime applications of satellites and aerospace exploration. V.Z.

A72-16309 Space flight targets and space technology of tomorrow (Raumfahrtziele und Weltraumtechnik von morgen). K. A. Ehrlicke (North American Rockwell Corp., Space Div., Downey, Calif.). *Astronautik*, vol. 8, Aug.-Dec. 1971, p. 95-109. In German.

The importance of space for future development of mankind is discussed. The principal targets of human endeavor are outlined, and possibilities offered in the future to mankind by a systematic exploitation of space are examined. Trends in future space flight technology are defined. Particular attention is given to such aspects as conservation of the natural terrestrial environment, recovery of raw materials from extraterrestrial sources, manufacture and power generation in space, etc. O.H.

A72-17092 # Project Skylab - Skylab and Soyuz in an American-Soviet joint venture in space. C. R. Konkel and W. James (McDonnell Douglas Aircraft Co., St. Louis, Mo.). *AIAA Student Journal*, vol. 9, Dec. 1971, p. 32-37.

Technological evaluation of a prospective joint American-Soviet space mission indicated that a combined Skylab-Soyuz space vehicle could be flown with medium or little hardware impacts on the vehicles and that both vehicles could carry out their portions of the required rendezvous procedures. It is also believed that this mission would have a critically stable orbiting vehicle if only Skylab CMG are used for vehicle attitude control, and would provide increased scientific return, improvement of modifications for future space cooperation and financial savings to both parties. V.Z.

A72-18230 # The ERTS program (Das ERTS-Programm). K. G. Jacobs (Bundesministerium für Bildung und Wissenschaft, Bonn, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Symposium über Fernerkundung der Erdoberfläche, Munich, West Germany, Dec. 9, 1971, Paper 71-139*. 14 p. In German.

The history and the objectives of the ERTS program are briefly reviewed. Detailed attention is given to a description of the mission requirements, payload, orbital characteristics, earth stations, data processing, and the overall satellite system. International features of the program are emphasized. Elements of future earth resources survey programs are outlined. O.H.

A72-18523 # Space methods for terrestrial studies (Kosmicheskie metody zemlevedeniia). B. V. Vinogradov and K. Ia. Kondrat'ev. Leningrad, Gidrometeoizdat, 1971. 224 p. 73 refs. In Russian.

The application of satellites to such scientific fields as meteorology, hydrology, oceanography, geomorphology, geobotanics, geog-

raphy, pedology, and atmospheric physics is examined. TV pictures and photographs obtained from various satellites are analyzed, and the preparation and characteristics of mosaics which provide local and global information on the natural environment are discussed. The book is intended for scientists dealing with these fields. V.P.

A72-18609 Space for mankind's benefit; Proceedings of the First International Space Congress, Huntsville, Ala., November 15-19, 1971. Preliminary Volume and Supplement. Congress sponsored by the Huntsville Association of Technical Societies. Huntsville, Ala., Huntsville Association of Technical Societies, 1971. Preliminary Volume, 359 p.; Supplement, 38 p.

Papers describing space programs as contributors to the solution of problems faced by various nations. Subjects covered include the Skylab; the Space Shuttle; communications, educational, meteorological, and ecological satellites; aerospace medical research; terrestrial feature surveys; power generation; and manufacturing in space. V.Z.

A72-18610 # Automated satellites - Silent servants. C. D. Graves (TRW Systems Group, Redondo Beach, Calif.). In: Space for mankind's benefit; Proceedings of the First International Space Congress, Huntsville, Ala., November 15-19, 1971. Preliminary Volume. Huntsville, Ala., Huntsville Association of Technical Societies, 1971, p. 1-1 to 1-18.

Review of NASA's Space Applications Program covering Communication and Navigation satellites and Earth Observations satellites with their potential for future uses in a wide range of applications, from transmission of telephone and television programs to the precision location of aircraft and ships. Various specific examples of such applications are discussed, including natural resource evaluations, geological and cartographic applications, weather forecasts, hurricane observations, and educational and health-service applications. V.Z.

A72-18611 # Skylab. G. V. Butler (McDonnell Douglas Astronautics Co., Huntington Beach, Calif.). In: Space for mankind's benefit; Proceedings of the First International Space Congress, Huntsville, Ala., November 15-19, 1971. Preliminary Volume. Huntsville, Ala., Huntsville Association of Technical Societies, 1971, p. 2-1 to 2-8.

Discussion of Skylab - an experimental space station designed to provide a comfortable environment for a three-man crew staying for periods of up to 56 days in orbit 270 miles from the earth. The space station is scheduled to be launched in 1973 for a mission involving rendezvous with an Apollo spacecraft crew rotation, and a program of more than 50 onboard experiments in space biology, medical tests, earth resources mapping, casting and welding, semiconductor technology, and star observations. V.Z.

A72-18614 # Satellite observations of temporal terrestrial features. G. Rabchevsky (Allied Research Associates, Inc., Concord, Mass.). In: Space for mankind's benefit; Proceedings of the First International Space Congress, Huntsville, Ala., November 15-19, 1971. Preliminary Volume. Huntsville, Ala., Huntsville Association of Technical Societies, 1971, p. 13-1 to 13-39. 37 refs.

In the eleven years since the launch of the first orbiting meteorological satellite TIROS I on April 1, 1960, over one million pictures of the earth have been recorded by 25 weather satellites. During the ten manned orbital flights of the Gemini Program, the astronauts took over 2,400 70 mm. color photographs; coverage obtained from Apollo 6, 7, and 9 missions comprises a total of 2,100 pictures. This coverage, at various times, scales and geographic locations, has given us a unique look at the dynamic features of the earth on a daily, weekly, seasonal, and yearly basis. This report will review some of these observations and their utility to the various earth science disciplines. (Author)

A72-19177 Earth sciences in the satellite age /Teledetection/ (Les sciences de la terre à l'heure des satellites /Télétection/). J. Pouquet (Aix-en-Provence, Université, Aix-en-Provence, Bouches-du-Rhône, France). Paris, Presses Universitaires de France (Collection SUP Le Physicien, No. 5), 1971. 259 p. 157 refs. \$4.30. In French.

Following a brief review of the beginnings of remote sensing, the basic principles are outlined. These make use of various bands of the spectrum, including the visible and near infrared range, the invisible range, and emitted and reflected radiations. It is considered that remote sensing techniques will occupy first place in earth science studies. Types of satellites are described. The problem of the real hour is discussed, followed by description of satellite instrumentation. Satellites intended for earth science studies are NERO, SCMR and ESMR, RBV, and MSS (ERTS A and B). Treatment of information received from satellites is studied, and comparative evaluation is made of aircraft vs satellites. The use of manned satellites, and general principles of interpretation are considered. Some geopedological and nongeopedological examples are discussed, as well as prospects for the future. F.R.L.

A72-19270 Hawaii International Conference on System Sciences, 5th, University of Hawaii, Honolulu, Hawaii, January 11-13, 1972, Proceedings. Conference sponsored by the University of Hawaii, the U.S. Army, the U.S. Navy, the Regional Medical Program of Hawaii, the Digital Equipment Corp., and the National Science Foundation. Edited by A. Lew. North Hollywood, Calif., Western Periodicals Co., 1972. 662 p. Price, \$35.; Proceedings and Supplement, \$50.

The topics concern the state of the art in system sciences and cover system theory, pattern recognition and artificial intelligence, communication theory, space systems in the 1970's, computer-aided instruction and graphics, game theory, optimal control, computer systems, modeling of ecological systems, fault detection, stochastic control, and programming, coding and radar techniques. V.Z.

A72-19276 * The Earth Resources Technology Satellites ERTS-A and -B. W. E. Scull (NASA, Goddard Space Flight Center, Greenbelt, Md.). In: Hawaii International Conference on System Sciences, 5th, University of Hawaii, Honolulu, Hawaii, January 11-13, 1972, Proceedings. North Hollywood, Calif., Western Periodicals Co., 1972, p. 66-69.

The Earth Resources Technology Satellites, ERTS-A and -B, are a significant part of the NASA Earth Resources Survey Program. A general description of the requirements and implementation of the ERTS system - sensors, spacecraft, operational control, and data processing - developed to acquire, process, and distribute multispectral images of the earth's surface is presented. (Author)

A72-19452 Colloquium on the Law of Outer Space, 13th, Konstanz, West Germany, October 4-10, 1970, Proceedings. Colloquium sponsored by the International Astronautical Federation. Edited by M. D. Schwartz (California, University, Davis, Calif.). Davis, University of California; South Hackensack, N.J., Fred B. Rothman and Co., 1971. 385 p. In English, French, and Spanish. \$20.

Questions of the United Nations organization and the legal problems of outer space are examined. Special reports on legal aspects of various specific space problems are discussed, including reports on United Nations institutions concerned with space activities, questions regarding the establishment of an international outer space agency, legal aspects of orbiting international laboratories, and the legal status of the natural resources of the moon and other celestial bodies. Specialized agencies of the United Nations are also considered, along with regional intergovernmental organizations and future activities of the various international organizations in the field of space law. G.R.

A72-19487 # Survey from space of earth resources. O. F. Brital (Universidad del Salvador; National Institute of Air and Space

Law, Buenos Aires, Argentina). In: Colloquium on the Law of Outer Space, 13th, Konstanz, West Germany, October 4-10, 1970, Proceedings. Davis, University of California; South Hackensack, N.J., Fred B. Rothman and Co., 1971, p. 197-202. 6 refs.

The various legal aspects of surveying earth resources from space are examined from the point of view of the rules of international law. In particular, the question is discussed of whether these activities are adequately covered by the existing legal provisions, and to what extent modifications should be introduced into the applicable law. It is concluded that the terms of the Treaty of January 27, 1967 do not prohibit the survey from space of natural resources, and that these activities shall be in conformity with the terms and conditions of this Treaty, with those contained in the Agreement on the rescue of astronauts and the return of objects launched into outer space, and with the Resolutions of the General Assembly of the United Nations regarding the sovereignty over natural resources. O.H.

A72-19475 # Future activities and actions of the various international organizations in the field of space law - General report. V. Kopal. In: Colloquium on the Law of Outer Space, 13th, Konstanz, West Germany, October 4-10, 1970, Proceedings.

Davis, University of California; South Hackensack, N.J., Fred B. Rothman and Co., 1971, p. 322-329. 33 refs.

Consideration of certain legal problems confronting the United Nations in the field of space law. Some problems of space communications are noted, including the regulation of technical questions such as the allocation of frequency bands, the adoption of appropriate definitions, etc., problems connected with the establishment of space communication systems, and problems connected with direct broadcasting from satellites. Other problems considered are the optimum use of geostationary orbits, the need for international cooperation in the use of space communication for education and development, problems connected with copyrights and other immaterial rights. Two significant projects involving international cooperation are reviewed - namely, a world weather watch program and an earth resources surveying project. Finally, the question of legal title for activities performed by an individual state in the course of explorations of the moon and other celestial bodies is weighed against the established principle of nonappropriation of outer space. A.B.K.

A72-19476 # New developments of earth satellite law. E. Brooks. In: Colloquium on the Law of Outer Space, 13th, Konstanz, West Germany, October 4-10, 1970, Proceedings. Davis, University of California; South Hackensack, N.J., Fred B. Rothman and Co., 1971, p. 337-352. 49 refs.

Discussion of the legal aspects of earth satellites under the space treaty. There would seem to be no fundamental distinction between manned earth orbiting stations and remote sensing satellites actually in operation in earth orbit. Important consequences flow from the fact of registration of the space vehicle although, in areas of rescue and return, the Rescue and Return agreement may have transferred certain rights from the state of registration to the state of launching. Though both the U.S. and the USSR, and perhaps other nations, have used remote sensing devices to detect military installations, there has been no agreement as to whether these actions are consonant with international law. The heart of the problem is security from nuclear attack. The questions of whether there is a duty of states to disclose resource data, and of the use by states of resource data collected by them are studied. F.R.L.

A72-20305 The satellites for the survey of the earth resources (Les satellites d'observation des ressources terrestres). J. Georget (Société Nationale Industrielle Aérospatiale; Centre de Documentation de l'Armement, Paris, France). L'Aéronautique et l'Astronautique, no. 33, 1972, p. 5-16. 27 refs. In French.

Before reviewing the current programs regarding the remote evaluation of the earth resources and emphasizing their economical

aspects, this paper starts with a survey of the application area of the ecographic satellites, with a statement of the parameters determinative of the selection of the orbit on which they should be placed and with a specific description of the sensors designed to equip them.

(Author)

A72-20977 **The Space Shuttle - Concept and implications.** D. J. Farrar (British Aircraft Corp., Ltd., London, England). *Spaceflight*, vol. 14, Mar. 1972, p. 104-108.

The features of the improved space transportation system, consisting of the Space Shuttle, the Space Tug, and the Space Station, are outlined. The services which the Space Shuttle could provide and the benefits of the space-borne survey system are reviewed. Economics of shuttle missions in general, and for Europe in particular, is examined. Finally, implications of the Space Shuttle are discussed. O.H.

A72-21201 **Guidelines of the program of French space applications (Lignes directrices du programme d'applications spatiales français).** A. Lebeau (Centre National d'Etudes Spatiales, Brétigny-sur-Orge, Essonne, France). *L'Onde Electrique*, vol. 52, Jan. 1972, p. 3-7. In French.

Synopsis of the guiding principles and overall outlines of the French space application program. From its very origin, its main objective is shown to have been the elevation of Europe to a status of autonomy in regard to space application capabilities. The orientation of the program is reviewed for each space application field. The application fields discussed include: telecommunications, meteorology, survey of natural resources, and air and sea traffic control.

M.V.E.

A72-22311 **Institute of Electrical and Electronics Engineers, Annual International Geoscience Electronics Symposium, 3rd, Washington, D.C., August 25-27, 1971, Selected Papers.** *IEEE Transactions on Geoscience Electronics*, vol. GE-10, Jan. 1972, 83 p.

Description of theoretical, experimental, and instrumentation developments in the application of electronics to the exploration, evaluation, exploitation, and control of the land, sea, air, and space environments. Topics considered include measurements of 2.25-cm backscatter from sea surfaces, use of lasers in pollution monitoring, a water quality monitoring system, a wave follower for field study of air-sea interactions, Doppler returns from two-dimensional random rough surfaces, hydrological data collection by geostationary satellites, analysis of sea photographs for energy spectra, acoustic radar design and operation, a traverse gravimeter for the lunar surface, and objectives of the Skylab S-193 Altimeter Experiment.

T.M.

A72-22935 * **American space station activities.** C. W. Mathews (NASA, Washington, D.C.). *Aeronautical Journal*, vol. 76, Feb. 1972, p. 83-96.

The concept of a research and applications facility permanently operating in earth orbit is described. A brief outline of the Skylab missions is given. The kinds of investigation presently envisioned are discussed; they include activities in the physical and life sciences, applications, technology, and operations. In addition, the specialized capabilities within the space station are described. O.H.

A72-23298 # **Psychological, physiological, and methodological foundations of the interpretation of aerial photographs - Education and training of interpreters (Psychologische, physiologische und methodologische Grundlagen der Interpretation von Luftbildern - Ausbildung und Trainieren der Interpretatoren).** D. M. Kudritskii (Laboratorium für Aeromethoden, Leningrad, USSR). In: Internationale Gesellschaft für Photogrammetrie, International Symposium on Photointerpretation, 3rd, Dresden, East Germany, September 10-16, 1970, Reports. Part 2. Leipzig, Landwirtschaftsausstellung der DDR, 1971, p. 577-588. In German.

The stages of photointerpretation include the recognition of the research objective, the determination of the characteristics of the

objective, and the analysis of the relations of the objective with the environment. Inductive and deductive approaches are used in the interpretation of aerial photos. The education of the interpreters of aerial photographs is to be based on the study of the technical terminology and the technology of photointerpretation methods. It is pointed out that all specialists in the field of the exploration and the utilization of natural resources should receive a training in the methodology and technology of the interpretation of aerial photos.

G.R.

A72-24323 **Towards earth resources satellites - The American ERTS and Skylab programs.** D. Steiner (Waterloo, University, Waterloo, Ontario, Canada). *Photogrammetria*, vol. 27, Dec. 1971, p. 211-251. 78 refs. National Research Council of Canada Grant No. A-7501.

Two NASA projects scheduled for 1972 and later deal with remote sensing of earth resources from space: ERTS (Earth Resources Technology Satellite) and Skylab (Apollo Applications Program). This paper firstly examines developments which led to the establishment of the two programs (section 1). It then gives essential technical information concerning the spacecrafts, their orbits and attitudes, the sensors and their coverage capabilities (section 2), the image characteristics, such as scale, resolution, geometry and radiometric properties (section 3) as well as the organization of data handling on the ground and processing considerations and operations (section 4). No attempt is made to make a forecast with respect to applications. However, some indications based on ERTS simulation studies are given in section 1.5, and a table of ground resolutions required for various applications provides the reader with a basis for comparison with expected resolutions. (Author)

A72-25253 * # **Prospective space developments - Blue sky and non-blue sky.** W. von Braun (NASA, Washington, D.C.). *Astronautics and Aeronautics*, vol. 10, Apr. 1972, p. 26-35.

Discussion of the significance for man's future of the practical benefits to be yielded by developments successfully concluded or still in progress over the wide range of technologies involved in current and future space activities. Reviewed benefit potentials pertain to space-age communications, transportation, computer developments, information networks, education, home communications centers, holography, life-support systems, power systems, manufacturing in space, meteorology, and earth resources. A strong case is made for the indissoluble involvement of this nation's self-interest in the achievement of national space goals. M.V.E.

A72-26098 * # **Science, society and the space program.** T. P. Stafford (USAF, Washington, D.C.; NASA, Manned Spacecraft Center, Houston, Tex.). *AIAA Student Journal*, vol. 10, Feb. 1972, p. 3-5.

Exposition of the contributions the space program can make toward improving the quality of life. The contribution involves both short-range application of space technology and the long-range search for knowledge. Large land areas can be surveyed from spacecraft to determine not only whether land is tillable, but what kind of crops will flourish. The space communications program can reach many millions of people more economically than other methods. The long-range aspects are concerned with the effect of modification of the environment. F.R.L.

A72-27688 **Earth resources satellites - Rescuing earth from outer space.** W. D. Siuru, Jr. (USAF, Washington, D.C.) and W. G. Holder. *Spaceflight*, vol. 14, May 1972, p. 167-171, 184.

Review of the NASA Earth Resources Survey (ERS) program, which will probably benefit the common man more than any other space program. Satellites have the advantage of being able to see a very large area at one time, and can produce photographs which are really maps with very little distortion. They have important advantages for oceanography. The ERS program consists of viewing the earth from aircraft as well as from unmanned and manned satellites. The bulk of the work to date and for some time into the

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future will be devoted to developing and testing equipment and techniques, and in acquainting the potential users with the available information. Some particulars of the Earth Resource Technology Satellites (ERTS) are given. F.R.L.

A72-28801 International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Conference sponsored by the American Meteorological Society. Boston, American Meteorological Society, 1972. 437 p. In English and French. Members, \$15.; nonmembers, \$20.

Meteorological support of aerospace operations is discussed together with studies of communication systems, missiles, space shuttles, orbiting laboratories, and in situ measurements. Subjects examined include remote soundings, atmospheric structure and circulation, trends in air quality related to worldwide aircraft operations, terminal weather, sensor equivalent visibility, severe convective storms, hail, icing, wind shear, and turbulence. G.R.

A72-28805 * # Development of four-dimensional atmospheric models and application techniques for space mission simulation. D. B. Spiegler and M. G. Fowler (Environmental Research and Technology, Inc., Lexington, Mass.). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 18-24. 7 refs. Contracts No. NAS8-25618; No. NAS8-26928.

The major objective of the four-dimensional atmospheric model program is to provide global profiles of moisture, temperature, pressure, and density from the surface to 25 km altitude. These models may then be used as input to the attenuation models for the purpose of simulating earth resource missions. Aspects of data processing are discussed together with homogeneous moisture regions, details regarding four-dimensional atmospheric models, and mission simulation procedures. G.R.

A72-28816 # Weather support to earth-oriented experiments from aircraft and spacecraft. K. M. Nagler (NOAA, National Weather Service, Silver Spring, Md.) and A. N. Sanderson (NOAA, National Weather Service, Houston, Tex.). In: International Conference on Aerospace and Aeronautical Meteorology, 1st, Washington, D.C., May 22-26, 1972, Preprints. Boston, American Meteorological Society, 1972, p. 83-86. 5 refs.

Discussion of the use and planning of weather forecasting in the weather support of several past, current, and future NASA programs involving earth-oriented viewing or sensing experiments from spacecraft or aircraft. The program review covers the Gemini and Apollo experience, the presently conducted Earth Observations Aircraft Program, including the 1971 corn blight watch, and the forthcoming Earth Resources Technology Satellite and Skylab programs. M.V.E.

A72-31135 International cooperation in space operations and exploration; Proceedings of the Ninth Goddard Memorial Symposium, Washington, D.C., March 10, 11, 1971. Symposium sponsored by the American Astronautical Society. Edited by M. Cutler (Bellcomm, Inc., Washington, D.C.). Tarzana, Calif., Univelt, Inc.; American Astronautical Society (AAS Science and Technology Series. Volume 27), 1971. 186 p. \$11.00.

NASA's plans for the 70's are discussed together with views of the American and European industries, on NASA's plans, earth resources survey systems, and benefits from space applications. Other subjects considered include critical systems and technologies for the future, advanced air traffic control systems, and aspects of international cooperation in space. Attention is also given to the establishment of the permanent Intelsat and an assessment of U.S.-USSR cooperation in space. G.R.

A72-31136 * NASA's plans for the 70's. W. von Braun (NASA, Washington, D.C.). In: International cooperation in space

operations and exploration; Proceedings of the Ninth Goddard Memorial Symposium, Washington, D.C., March 10, 11, 1971. Tarzana, Calif., Univelt, Inc.; American Astronautical Society, 1971, p. 7-19.

NASA's plan for the 70's is based on six objectives. These objectives include continued exploration of the moon, continued exploration of the planets and the universe, a substantial reduction in the cost of space operations, an expansion of man's capability to live and work in space, practical applications of space technology, and the encouragement of greater international cooperation in space. Applications of space technology considered are in the areas of meteorology, earth physics, earth resources, communications and navigation, astronomy, and space physics. Attention is given to the Skylab and the Space Shuttle. G.R.

A72-31142 Earth resources survey systems - The activities of developing countries. H. J. Ricciardi (United Nations, New York, N.Y.). In: International cooperation in space operations and exploration; Proceedings of the Ninth Goddard Memorial Symposium, Washington, D.C., March 10, 11, 1971. Tarzana, Calif., Univelt, Inc.; American Astronautical Society, 1971, p. 83-112. 9 refs.

The essential elements of a complete model of an earth resources survey (ERS) system are considered together with attempts to establish a logical course of development. An approach making use of multistate 'relevance matrices' has been developed to describe the analytical framework for synthesis and analysis of possible systems. The ERS mission system is discussed together with possible benefits, the ground truth problem, aspects of data analysis, first generation experimental satellites, the operational system, the needs of developing countries, and the activities of developing countries. G.R.

A72-31143 * Benefits from space applications in the 80's. W. von Braun (NASA, Washington, D.C.). In: International cooperation in space operations and exploration; Proceedings of the Ninth Goddard Memorial Symposium, Washington, D.C., March 10, 11, 1971. Tarzana, Calif., Univelt, Inc.; American Astronautical Society, 1971, p. 113-125.

A summary of our nation's space capability as we enter the decade of the 1980's is given. The environment in which man lives; the demands he places on this environment; and the natural and man-made problems that beset him are examined. The application of our space capability to help man solve some of his problems, and the attendant benefits that would be derived, are postulated. Particular emphasis is given to man's more pressing problems: the resources of the earth, the weather, and communications needs. The benefits are viewed as accruing to all peoples of the world, which could be ultimately attained through cooperative efforts on an international basis. (Author)

A72-31226 Space activity in the field of ecology and earth resources; International Convention on Space, 12th, Rome, Italy, March 23-25, 1972, Proceedings (Attività spaziali nel campo dell'ecologia e delle risorse terrestri; Convegno Internazionale sullo Spazio, 12th, Rome, Italy, March 23-25, 1972, Atti). Convention supported by the Ministero degli Affari Esteri and Associazione Industrie Aerospaziali. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1972. 406 p. In Italian, English, French, and German.

Space activities in the fields of ecology and earth resources are considered, covering space technologies for meteorological and atmospheric pollution surveys, space technologies for earth environment and oceanographic surveys, earth resources survey techniques based on space and aerospace means, and finally specific applications of space surveys. Topics include the United Nations interest in space surveys, infrared techniques and applications, and ground truth station development. B.B.M.

A72-31227 # The United Nations and the survey of earth resources by satellites (Le Nazioni Unite e il rilevamento delle risorse

terrestri a mezzo satelliti). F. Fiorio (United Nations, New York, N.Y.). In: Space activity in the field of ecology and earth resources; International Convention on Space, 12th, Rome, Italy, March 23-25, 1972, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1972, p. 23, 25-30. In Italian.

Description of the position and interest of the United Nations in the national and international activities related to the remote survey of earth resources and environmental pollution by satellites. The steps taken by the world organization for the elaboration of spatial rules are detailed. In conclusion, a global network of space stations and orbiting satellites transmitting information to the ground stations is envisioned for the future. B.B.M.

A72-31228 # FAO's interest in the application of remote sensing techniques. O. E. Fischnich (United Nations, Food and Agriculture Organization, Rome, Italy). In: Space activity in the field of ecology and earth resources; International Convention on Space, 12th, Rome, Italy, March 23-25, 1972, Proceedings.

Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1972, p. 31, 33-38.

Discussion of the interest of FAO in the application of the techniques to the survey and management of agricultural, forestry, and fisheries resources. Attention is given to the needs of developing countries, in which FAO can play its role in identifying the problems, priorities, and needs. F.R.L.

A72-31229 # Europe and remote sensing - Critical reflections and future prospects (L'Europe et la télédétection - Réflexions critiques et perspectives d'avenir). R. Tessier and J. Plevin (ESRO, Neuilly-sur-Seine, Hauts-de-Seine, France). In: Space activity in the field of ecology and earth resources; International Convention on Space, 12th, Rome, Italy, March 23-25, 1972, Proceedings.

Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1972, p. 53, 55-64. In French.

Consideration of civilian use of military detection techniques, such as camouflage detection film, the infrared camera, side-scanning radar, and the millimeter wave radiometer. Remote sensing is defined as a group of methods of acquisition and extraction of information contained in all sources of radiant energy, making use of the senses of sight and hearing. Attention is given to certain difficulties encountered in the use of remote sensing in Europe, and to results accomplished in various European nations. The activities of ESRO with earth resources survey satellites are reviewed. F.R.L.

A72-31234 # New prospects for meteorology with second generation satellites (Nuove prospettive per la meteorologia con i satelliti della seconda generazione). B. Bizzarri (Aeronautica Militare, Servizio Meteorologico, Rome, Italy). In: Space activity in the field of ecology and earth resources; International Convention on Space, 12th, Rome, Italy, March 23-25, 1972, Proceedings.

Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1972, p. 131, 133-145. 7 refs. In Italian.

Progress in meteorology is shown to be dependent on the development of space technologies. The usefulness of ERTS and manned space programs is noted. Meteorological satellite missions are listed, and their evolution is described. The constitution of a meteorological space observatory is discussed, citing the system required for GARP (the first global experiment) and the possible European contribution. B.B.M.

A72-31245 # General application of remote sensing in earth resources. J. Bodechtel (Zentralstelle für Geo-Photogrammetrie und Fernerkundung, Munich, West Germany). In: Space activity in the field of ecology and earth resources; International Convention on Space, 12th, Rome, Italy, March 23-25, 1972, Proceedings.

Rome, Rassegna Internazionale Elettronica Nucleare

ed Aerospaziale, 1972, p. 303, 305-314. 6 refs.

Survey of space- and air-based remote sensing methods of earth observation, and review of some of their applications. The discussion of general principles of remote sensing includes such aspects as the electromagnetic spectrum used, distance between target and sensor, ground resolution, automation of qualitative and quantitative data evaluation, and methods of electronic image enhancement. Considered application fields include geology, soil science, geography, hydrology, land use, and forestry. M.V.E.

A72-32003 French space program - Report to COSPAR, world committee on space research (Programme spatial français - Rapport au COSPAR, comité mondial de la recherche spatiale). COSPAR, Plenary Meeting, 15th, Madrid, Spain, May 10-24, 1972, Paper. 108 p. 271 refs. In French.

Review of French activity in the field, the importance of which can be measured by the large number of satellites placed in orbit and the experiments carried out with rockets and balloons during the last ten years. Aspects of international cooperation are reviewed. Solar astronomy and astronomy outside the solar system are discussed. Attention is given to studies of the moon and planets, ionospheric and magnetospheric physics, aeronomy, meteorology, geodesy and geodynamics, terrestrial resources, and biology. F.R.L.

A72-32009 # Space activity in Norway 1971. COSPAR, Plenary Meeting, 15th, Madrid, Spain, May 10-24, 1972, Paper. 31 p. 72 refs.

Space activities in 1971 include a scientific program, an application program, and other activities, such as satellite geodesy and the investigation of earth resources. The scientific activities are mainly conducted at the University of Bergen, the Norwegian Defence Research Establishment, the Norwegian Institute of Cosmic Physics, the Auroral Observatory, the Mineralogical-Geological Museum, and the Norwegian Meteorological Institute. The application program is concerned with maritime satellite communications, data read-out from unmanned platforms, and satellite navigation and traffic control. G.R.

A72-32015 # Argentina report to COSPAR, Madrid-1972. COSPAR, Plenary Meeting, 15th, Madrid, Spain, May 10-24, 1972, Paper. 12 p.

Review of work now being carried out, making use of sounding rockets and balloons, with an outline of future projects. The Exametnet (Experimental Inter-American Meteorological Network), launched by Argentina, Brazil, and the USA carries out regular launchings of meteorological rockets. Plans are being made for the continuation in 1973 of the 'Galaxia' series of very large balloon launchings from Argentina in cooperation with various scientific institutions in the USA. F.R.L.

A72-32601 Environmental progress in science and education; Institute of Environmental Sciences, Annual Technical Meeting, 18th, New York, N.Y., May 1-4, 1972, Proceedings. Mount Prospect, Ill., Institute of Environmental Sciences, 1972. 610 p. Members, \$12.; nonmembers, \$20.

The subjects discussed are in the areas of water pollution, bioenvironmental engineering, data reduction, environmental health effects, marine environmental technology, and vacuum cryogenics. Other topics considered are related to social problems of noise, the recovery of nutrients from waste materials, laboratory management, shock and vibration, the remote sensing of the environment, nuclear radiation, corporate environmental protection, and the future environment. Aspects of air pollution technology are also examined, together with advances in industrial waste treatment.

G.R.

A72-36539 # Operational earth observation systems and resources management - A global program. H. Salasin and C. E. Cheeseman, Jr. (General Electric Co., Space Div., King of Prussia, Pa.). Canadian Aeronautics and Space Institute and American Institute of Aeronautics and Astronautics, Meeting on Space - 1972

Assessment, Ottawa, Canada, July 10, 11, 1972, AIAA Paper 72-735. 7 p. Members, \$1.50; nonmembers, \$2.00.

Aspects of current program development are examined, giving attention to ERTS, EOS, SKYLAB, and ERAP. Current programs are experimental in nature. Factors which have to be achieved before an operational program can be implemented are considered. A description of an earth observation system for the 1980's is given. The sensor platforms for this system include geostationary satellites, low orbit satellites, high altitude aircraft, and ground sensors. Ground data processing and handling systems are discussed together with aspects of data utilization. G.R.

A72-36545 # The infrastructure for international space operations. F. X. Kane (TRW Systems Group, Redondo Beach, Calif.). *Canadian Aeronautics and Space Institute and American Institute of Aeronautics and Astronautics, Meeting on Space - 1972 Assessment, Ottawa, Canada, July 10, 11, 1972, AIAA Paper 72-739.* 12 p. 44 refs. Members, \$1.50; nonmembers, \$2.00.

In the context of international space operations, this paper describes the space infrastructure (launch, tracking, communications, and readout sites) which have made day-to-day use of space a reality. It presents a survey of the space facilities of the principal countries (U.S., USSR, France, Australia, Japan, Italy) and international organizations (INTELSAT, ESRO, ELDO, NATO) involved in space operations at the start of the decade of the 70's and a forecast of how those facilities will be expanded. It also delineates how other countries are engaged in the use of space through readout, telemetry and tracking of satellites for communications, weather, navigation, geodesy, and earth resources. The major conclusions are that space operations have been international in character and have been made possible because of a global network of facilities. (Author)

A72-36547 # International cooperation in earth resources study. M. Beheshti (Martin Marietta Corp., Denver, Colo.) and G. A. Coddington, Jr. (Colorado University, Boulder, Colo.). *Canadian Aeronautics and Space Institute and American Institute of Aeronautics and Astronautics, Meeting on Space - 1972 Assessment, Ottawa, Canada, July 10, 11, 1972, AIAA Paper 72-741.* 15 p. 30 refs. Members, \$1.50; nonmembers, \$2.00.

Discussion of the merits of various possible bilateral and multilateral forms of international cooperation in the study of earth resources by means of earth-orbiting space laboratories, in the light of its objectives, their significance for the international community, and the needs and contribution potentials of community members. A draft treaty for the creation of a new international agency deemed capable to provide the most desirable form of cooperation in earth resource studies is presented. M.V.E.

A72-36548 # A possible Canadian role in future global remote sensing. A. F. Gregory. *Canadian Aeronautics and Space Institute and American Institute of Aeronautics and Astronautics, Meeting on Space - 1972 Assessment, Ottawa, Canada, July 10, 11, 1972, AIAA Paper 72-742.* 11 p. 19 refs. Members, \$1.50; nonmembers, \$2.00.

It has been proposed that a permanent global environmental monitoring system be developed. Such a system would provide information for the equitable management of the human environment and of the world's resources. The nature of an environmental management system is discussed together with problems regarding the paradigmatic interface between the concepts of sensing technologists and those of the ultimate users. The Canadian program of remote sensing is a multistage, multisensor pilot program that will combine observations by sensors in satellites, in aircraft, and on the ground. G.R.

A72-37274 * NASA'S second decade in space. E. J. Manganiello (Society of Automotive Engineers, Inc., New York, N.Y.; NASA, Lewis Research Center, Cleveland, Ohio). *Institution of Mechanical Engineers and Royal Aeronautical Society, Joint*

Meeting, London, England, June 29, 1972.) Institution of Mechanical Engineers, Proceedings, vol. 186, no. 42, 1972, p. 527-545.

Advances in space science during the last decade are reviewed. The basic scientific goals of NASA's Planetary Program are to increase man's understanding of the origin and evolution of the solar system, the origin and evolution of life, and the earth, through a comparative study of the other planets. Studies of the planets will be continued during the second decade. Aspects of manned space flights are discussed, giving attention to the Skylab workshop, and the Space Shuttle. The applications program is divided into four major areas including meteorology, communications and navigation, geodesy, and earth resources. Areas of aeronautical research are also examined. G.R.

A72-40851 Annual International Conference on Communications, 8th, Philadelphia, Pa., June 19-21, 1972, Conference Record. Conference sponsored by the Institute of Electrical and Electronics Engineers. New York, Institute of Electrical and Electronics Engineers, Inc. (IEEE ICC Conference Record. Volume 8), 1972. 1176 p. Members, \$15.; nonmembers, \$20.

Computer simulation of a digital satellite communications link, techniques for dealing with the effects of bad weather in satellite communications systems, and the satellite system as an integrated telecommunications switching center are among the topics covered in papers concerned with European communications satellites. Other areas covered include interaction of man-made noise with communication, advances in teleprinters and data apparatus, and technology for future satellite systems.

M.V.E.

A72-40864 The cost-effectiveness of advanced remote sensing systems. K. B. Craib (Aero Service Corp., Philadelphia, Pa.). In: Annual International Conference on Communications, 8th, Philadelphia, Pa., June 19-21, 1972, Conference Record.

New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 9-4 to 9-9. 12 refs.

Major problems associated with conventional data collection techniques have been the relatively high cost per unit area surveyed and the limited availability of skilled manpower. It has been shown (Craib, 1972) that mineral exploration surveys conducted from an altitude of 25,000 ft could provide exactly the same spatial resolution and four times the spectral detail at one-half the cost of a conventional survey from 10,000 ft altitude. Thermal infrared scanners have been shown to be of significant value for the analysis of water currents, distribution patterns, and various types of pollution. F.R.L.

A72-44648 # Weather satellites - Their role in the application of environmental services to the marine industries. R. A. Raguso (Bendix Commercial Service Corp., Teterboro, N.J.). *Institute of Navigation, Annual Meeting, 28th, U.S. Military Academy, West Point, N.Y., June 27-29, 1972, Paper.* 24 p. 15 refs.

Review of the role of weather satellites in meeting the environmental information requirements of safety at sea. Refined knowledge of the relationship of changes in cloud form and pattern to surface wind force and direction and daily satellite photos of cloud patterns over the oceans are shown to leave no data gaps in providing comprehensive information on environmental interactions and hazards essential to ensuring safety throughout the sea areas of the world. The specific information services provided are reviewed. M.V.E.

A72-45115 # Key technological challenges of the earth resources technology satellite program. I. S. Haas, B. T. Bachofer, and G. P. Fishman (General Electric Co., Space Div., Philadelphia, Pa.). *International Astronautical Federation, International Astronautical Congress, 23rd, Vienna, Austria, Oct. 8-15, 1972, Paper.* 28 p.

Some of the considerations essential to the success of the earth resources technology satellite (ERTS) program are discussed in the

light of the experience gained since the first ERTS was launched on July 23, 1972. The specific topics examined include orbit and coverage parameters, spectral characteristics, system performance, and photographic interpretation and information extraction. M.V.E.

A72-45141 # Twenty-five years of plastic research balloons. O. C. Winzen (Winzen Research, Inc., Minneapolis, Minn.). *International Astronautical Federation, International Astronautical Congress, 23rd, Vienna, Austria, Oct. 8-15, 1972, Paper*. 19 p. 15 refs.

Some of the accomplishments of plastic balloons are reviewed, some of the production aspects of modern balloons are described, and new fields of application are examined. The balloon has been accepted by scientists as a serious research vehicle, alongside sounding rockets and satellites. The ability to float at level altitudes without vibration and noise for extended periods of time makes the balloon particularly attractive for the study of space astronomy and astrophysics. To bring about a vehicle of such high reliability required the establishment of new production facilities with highly developed quality control techniques. New plastic films had to be developed, capable of withstanding the extreme temperatures and conditions to which these balloons are subjected in flight. F.R.L.

A72-45185 # The role of the United Nations in earth resources satellites. E. Galloway (Library of Congress, Washington, D.C.). *International Astronautical Federation, International Astronautical Congress, 23rd, Vienna, Austria, Oct. 8-15, 1972, Paper*. 19 p. 16 refs.

The first Earth Resources Technology Satellite, ERTS-A, is the forerunner of an operational system using remote sensing as a technological tool to assist in meeting problems involved in protecting the earth's environment. Participants in this mission represent 34 foreign countries and two international organizations. The establishment of the United Nations working group on remote sensing of the earth by satellites is discussed together with United Nations organizations and methods for space and space-related functions. The conference of the United Nations on the human environment is reported and the question is considered whether the United Nations should draft a treaty on earth resources satellites. Problems regarding the international laws concerning outer space activities are also examined. G.R.

A73-11101 International Symposium on Space Technology and Science, 9th, Tokyo, Japan, May 17-22, 1971, Proceedings. Tokyo, AGNE Publishing, Inc., 1971. 1119 p. \$70.

Recent developments in scientific and engineering aspects of aerospace research are covered by papers dealing with propellants, structural elements, aerodynamics, spacecraft trajectories, environmental simulation studies, spacecraft and rocket projects, electronic equipment, telemetry and tracking procedures, guidance and control laws, systems engineering, space science, balloon equipment, and aerospace medicine and biology. Equipment design details, industrial processes, materials properties, test and evaluation techniques, and mathematical methods are described along with important results obtained in space exploration programs to date.

Individual items are announced in this issue.

T.M.

A73-11107 The Earth Resources Program - International benefits from space. D. J. Fink (General Electric Co., Space Div., Philadelphia, Pa.). In: *International Symposium on Space Technology and Science, 9th, Tokyo, Japan, May 17-22, 1971, Proceedings*. Tokyo, AGNE Publishing, Inc., 1971, p. 63-72.

This paper discusses the Earth Resources Program, with emphasis on the Earth Resources Technology Satellite (ERTS), which is now being built. The first flight is scheduled for the spring of 1972, when the data processing system will also be operational. The use of ERTS data is discussed for selected application samples, such as monitoring of crop disease; surveying of sea state and oceanic conditions; fishing; and ecology. The growth and extension of ERTS capabilities through future versions with improved sensors are also

shown. Emphasis is placed on the status, needs, and requirements for international participation and cooperation in Earth Resources Systems. (Author)

A73-11677 Earth resources exploration with a sortie laboratory within the framework of the Post-Apollo Program /PAP/ (Erderkundung mit Sortie Laboratory im Rahmen des Post-Apollo-Programms /PAP/). W. Stegmann (Messerschmitt-Bölkow-Blöhm GmbH, Ottobrunn, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 5th, Berlin, West Germany, Oct. 4-6, 1972, Paper 72-080*. 26 p. In German.

Consideration of the possibility of performing earth resources analyses from so-called sortie modules which operate only when docked at the Space Shuttle or Space Orbiter. The types of missions which might be performed with the aid of sortie modules are reviewed, and descriptions are given of the required booster systems and of the design of a hypothetical sortie lab for earth resources exploration. The payload capacity of the Orbiter is discussed, as well as the possibility of adding on experiments to the sortie lab. Some comments are made regarding the maintenance and reliability of the sortie lab, and estimates of general development costs for this lab are presented. A.B.K.

A73-11703 # Do we need an overall remote survey program in the Federal Republic (Brauchen wir in der Bundesrepublik ein Gesamtprogramm Fernerkundung). R. Mühlfeld (Bundesanstalt für Bodenforschung, Hanover, West Germany). *Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 5th, Berlin, West Germany, Oct. 4-6, 1972, Paper 72-072*. 11 p. In German.

Review of aerospace-based earth-resource survey methods, and assessment of the need for their use by Germany. The methods reviewed include radar records, passive microwave techniques, infrared scanning, infrared photography, multispectral photography and scanning, and absorption spectrometry for the determination of trace gases in the atmosphere. The need for a long-range comprehensive remote resource survey program tailored to Germany's particular requirements is shown to exist, and some specific recommendations are presented for initiating its implementation. M.V.E.

A73-11998 # Impact of space on world development. H. G. Stever (National Science Foundation, Washington, D.C.). *International Astronautical Federation, International Astronautical Congress, 23rd, Vienna, Austria, Oct. 8-15, 1972, Paper*. 26 p.

Consideration of such aspects of modern outer space technology as human conduct and thinking in terms of space ethic, space experience with its lessons, and impact of space achievements on the development of the world. Concerns with the total planetary system, with international society relationships, and with the processes in natural systems are defined as the principal elements of a space ethic. The viability of such an ethic in the emerging space word is discussed. Particular attention is given to international communications systems via satellites and remote sensing of earth resources as space activities requiring an ethical approach. It is believed that space applications can advance human general knowledge, support local and regional applications, stimulate economies, improve environments, and provide further means of international cooperation. V.Z.

A73-12226 Space research XII; Proceedings of the Fourteenth Plenary Meeting, Seattle, Wash., June 18-July 2, 1971. Volumes 1 & 2. Meeting sponsored by COSPAR, International Union of Geodesy and Geophysics, International Astronomical Union, and International Union of Radio Science. Edited by S. A. Bowhill, L. D. Jaffe, and M. J. Rycroft. Berlin, East Germany, Akademie-Verlag GmbH, 1972. Vol. 1, 799 p.; vol. 2, 955 p. Price of two volumes, \$81.12.

Topics discussed include the chemical, biological, physical, and mechanical properties of lunar soil; the atmosphere, geology, and

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figure of the moon; lunar laser experiments; investigations of Venus and Mars; studies of cosmic dust by direct observations and optical methods; the use of satellites and spacecraft for observation of the earth's surface and weather prediction; studies of the earth's neutral atmosphere; studies of the dynamics of the thermosphere and ionosphere above 120 km; studies of the ionosphere, including ionospheric refraction of radio waves; studies of the polar ionosphere and the precipitation of low-energy charged particles; studies of the magnetosphere, energetic charged-particle precipitation at high latitudes, energetic protons, VLF radio physics, and other related topics; topics from astronomy, including solar physics, the interstellar wind, UV radiation, cosmic rays, and general relativity; and, finally, the results of high-angular-resolution astronomical observations from space.

A.B.K.

A73-12264 # Summary of national activities in earth surveys. S. Ruttenberg. In: Space research XII; Proceedings of the Fourteenth Plenary Meeting, Seattle, Wash., June 18-July 2, 1971. Volume 1. Berlin, East Germany, Akademie-Verlag GmbH, 1972, p. 459-468.

A summary is given here of the national reports on activities in earth surveys presented at the 1971 COSPAR meeting. Reports were presented from the following countries: Argentina, Brazil, Canada, Finland, France, Federal Republic of Germany, India, Pakistan, USSR. Activities include applications of remote sensing technique for the study of land and sea surfaces in many fields, such as agriculture, forestry, geology, oceanography. (Author)

A73-13843 The use of orbital photography for earth-resources satellite mission planning. F. J. Wobber (Earth Satellite Corp., Washington, D.C.). *Photogrammetria*, vol. 28, Apr. 1972, p. 35-59. 13 refs.

Growing demands for scarce natural resources and for protection of the environment have brought increasing attention to the potential uses of survey satellites in the exploration and management of earth resources. This paper presents the results of continuing studies conducted using imagery taken from orbital and sub-orbital altitudes. These data indicate that the existing earth-orbital photography can be used not only to illustrate potential applications of future ERTS-A satellite imagery but to anticipate how operational factors such as resolution, illumination, and angle of view can enhance its interpretability. (Author)

A73-15126 Colloquium on the Law of Outer Space, 14th, Brussels, Belgium, September 20-25, 1971, Proceedings. Colloquium sponsored by the International Astronautical Federation. Edited by M. D. Schwartz (California, University, Davis, Calif.). South Hackensack, N.J., Fred B. Rothman and Co., 1972. 304 p. In English, Spanish, French, and Italian. \$20.

The establishment of orbiting laboratories and lunar laboratories is dealt with, and attention is given to earth environmental surveys and the legal status of the laboratories. The protection of the earth's environment; the evaluation, conservation, and development of terrestrial resources; and space telecommunications are considered. Related problems include prospects for legal progress on celestial bodies, the problem of the vertical limit of state sovereignty, and the future of international space cooperation in treaty making.

F.R.L.

A73-15143 # The evaluation, conservation, and international development of terrestrial resources from outer space (La evaluación conservación y desarrollo internacional de los recursos terrestres desde el espacio exterior). O. Fernandez-Brital. In: Colloquium on the Law of Outer Space, 14th, Brussels, Belgium, September 20-25, 1971, Proceedings. South Hackensack, N.J., Fred B. Rothman and Co., 1972, p. 95-98. 7 refs. In Spanish.

It is considered to be indispensable that an international convention governing the use of remote sensors from space vehicles

be established in order adequately to study earth resources. The convention should conform to the basic principles outlined in the Treaty of Jan. 27, 1967, and the resolutions adopted by the U.N. concerning natural resources. An organization should be set up to be charged with centralizing and regulating the activities, and with dispensing information, particularly for the benefit of developing nations.

F.R.L.

A73-15144 # Legal problems relating to the evaluation, conservation and development of earth resources by means of space objects. A. A. Cocca. In: Colloquium on the Law of Outer Space, 14th, Brussels, Belgium, September 20-25, 1971, Proceedings. South Hackensack, N.J., Fred B. Rothman and Co., 1972, p. 99-109. 14 refs.

The discussion concludes that the U.S. is the only country which has proposed a program of prospecting natural resources from satellites and which has developed and constructed the satellites and instrument packages for this purposes. Far from being clandestine, the U.S. policy seeks a most extensive international cooperation. All countries which might benefit from this program have been invited to participate in it. The U.S. has until now sustained from drafting an international agreement on a global scale, and prefers to conclude bilateral agreements with each nation concerned and to establish their respective financial responsibilities. On the other hand, there are many reasons which make it necessary and urgent to regulate satellite prospecting in terms of a general law that would equally protect all states, regardless of their participation. Some aspects of drafts submitted to the United Nations are examined.

V.P.

A73-15145 # Legal regulation of investigation of natural environment from outer space. V. S. Vereshchetin (Akademiia Nauk SSSR, Moscow, USSR). In: Colloquium on the Law of Outer Space, 14th, Brussels, Belgium, September 20-25, 1971, Proceedings. South Hackensack, N.J., Fred B. Rothman and Co., 1972, p. 110-114. 11 refs.

The legal aspects of the use of satellites for the prospecting of natural resources are discussed. Concern is expressed about the possibility that highly developed countries might use data on the natural resources of developing countries to the disadvantage of the latter. Means of preventing such activity of becoming a 'legalized economic espionage' are examined. The major task of legal experts is seen to consist in establishing laws and formulations that would protect the interests of developing countries and at the same time would not impair the development and use of satellite prospecting.

V.P.

A73-15376 NTC '72; National Telecommunications Conference, Houston, Tex., December 4-6, 1972, Record. Conference sponsored by the Institute of Electrical and Electronics Engineers and Communications Society. New York, Institute of Electrical and Electronics Engineers, Inc., 1972. 885 p. Members, \$20.; non-members, \$25.

Telemetry, communications, and remote control and guidance systems procedures and hardware are described in papers dealing with lunar experiments, satellite data collection, transportation, air defense, and medical applications. Topics examined include digital encoding techniques, video data compression, ERTS imagery data processing procedures, millimeter-wave satellite-link propagation experiments, remote piloted aircraft, signal detection methods, biomedical telemetry systems for monitoring physiological parameters in humans and animals, noise and propagation problems in mobile communications systems, analog and digital phase-locked loops, aerospace systems test and evaluation procedures, and computerized data processing.

T.M.

A73-15382 * The ERTS wideband image communication system. J. Pandelides (NASA, Goddard Space Flight Center, Greenbelt, Md.), W. J. Popowski, and R. N. VanVleet (GE Space Center, Valley Forge, Pa.). In: NTC '72; National Telecommunications Conference, Houston, Tex., December 4-6, 1972, Record.

New York, Institute of Electrical and Electronics Engineers, Inc., 1972, p. 7B-1 to 7B-10. 12 refs.

The ERTS payload includes a three camera return beam vidicon (RBV) television system and a four channel multispectral scanner system (MSS). The communications system described includes spacecraft wideband equipment plus unique payload processing equipment located at three NASA tracking stations. The RBV information, transmitted as analog FM with a baseband response of dc to 3.2 MHz, is telemetered, processed and recorded on a wideband video recorder. The MSS data, consisting of 24 analog sensor outputs, is digitized and encoded as 15 megabit per second PCM. The MSS data is then transmitted as analog FM, demultiplexed, and recorded on a 25 channel recorder. It is shown that bit error rate is an excellent indicator of MSS link performance while signal-to-noise ratio and distortion vs frequency adequately define RBV link performance. (Author)

A73-16181 The value of space research to humanity. W. von Braun. *Interavia*, vol. 27, Dec. 1972, p. 1321-1326.

NASA's next important project is the 'Skylab' space station, which is equipped with a solar observatory which makes it possible to observe the sun in the ultraviolet, visible, and X-ray ranges of the spectrum. In addition to great enlargement of knowledge of the sun, space research can be of value in locating food resources and mineral and petroleum deposits. The roles of communications-satellites are discussed. F.R.L.

A73-17004 # The problem of continuous survey of the earth, and kinematically consistent satellite systems. I (Zadacha o nepreryvnom obzore zemli i kinematicheski pravil'nye sputnikovye sistemy. I). G. V. Mozhaev. *Kosmicheskie Issledovaniia*, vol. 10, Nov.-Dec. 1972, p. 833-840. 14 refs. In Russian.

The problem of optimizing the motion parameters of satellite systems intended to provide a continuous survey of the earth is discussed. It is assumed that all the orbits are circular and of the same radius, and that the relative motion of the satellites does not vary in time. Systems which satisfy the necessary optimality conditions are proposed. V.P.

A73-17137 Social, economic and political factors associated with earth resources observation and information analyses. J. J. Hall (Boeing Co., Kennedy Space Center, Fla.). In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1.

Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 293-301. 5 refs.

Discussion of some of the interest conflicts between ecology and economics that arise, particularly in riparian environments, when a population-increase entailed growth in public service requirements is met by indiscriminate technology applications. Reviewed instances of such conflicts include the aborted cross-Florida barge canal project and the Florida Power and Light Company facility at Turkey point. M.V.E.

A73-17139 The cost-effectiveness of high altitude systems for regional resource assessment. K. B. Craib. (Aero Service Corp., Philadelphia, Pa.). In: Remote sensing of earth resources; Proceedings of the Conference on Earth Resources Observation and Information Analysis Systems, Tullahoma, Tenn., March 13, 14, 1972. Volume 1. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1972, p. 315-337. 19 refs.

Comparative study of the costs and capabilities of traditional airborne photographic surveys and multispectral surveys conducted at different altitudes with different platforms. It is shown that high-altitude multiband remote sensing surveys for regional reconnaissance and mineral exploration can be much less costly and more effective than traditional lower-altitude methods presently in use. The ability of relatively unsophisticated systems to perform regional

resource surveys and assessments is shown, and a minimum cost-benefit ratio of 2:1 is demonstrated for regional geological surveys at moderately high altitudes. This ratio is shown to improve as survey area is increased. A.B.K.

A73-18018 * Revolutionary implications of the space shuttle. W. von Braun (NASA, Washington, D.C.). (New York Academy of Sciences, Conference on Planetology and Space Mission Planning, 3rd, New York, N.Y., Oct. 28-30, 1970.) New York Academy of Sciences, *Annals*, vol. 187, Jan. 25, 1972, p. 283-292.

The space shuttle concept, generated to meet the stringent requirement for a low-cost transportation system for further exploration and utilization of space, is discussed. By virtue of being a recoverable and reusable delivery vehicle, the space shuttle will provide a substantial reduction in recurring expenses associated with expendable launch vehicles. With its generous volume capacity and weight capability, the shuttle will have a drastic impact on all payloads, regardless of their destination, and will be able to recover spacecraft on a cyclic basis in order to permit their updating and refurbishing for later reuse. The shuttle's maintenance responsibilities may also involve performing scheduled or unscheduled repairs of malfunctioning satellites, either in orbit or after landing. The impact of the space shuttle, as a research laboratory, on the method of space experimentation has even more far-reaching implications. V.P.

A73-18026 An international space station program. R. B. Demoret and G. W. Morgenthaler (Martin Marietta Corp., Denver, Colo.). (New York Academy of Sciences, Conference on Planetology and Space Mission Planning, 3rd, New York, N.Y., Oct. 28-30, 1970.) New York Academy of Sciences, *Annals*, vol. 187, Jan. 25, 1972, p. 389-405. 11 refs.

Discussion of the objectives and political, economical, and cultural aspects of an international space station program which is visualized as a joint effort of international technology and science to be completed between 1979 and 1984. The U.S. Skylab program, the USSR Soyuz station, the Space Shuttle, and the UNESA organizational scheme are reviewed. Stages in the future development of the international space station by joint U.S., USSR, and UNESA efforts are discussed. V.Z.

A73-19112 Earth Resources Technology Satellite. D. Dooling, Jr. *Spaceflight*, vol. 15, Feb. 1973, p. 53-56. 8 refs.

The ERTS program consists of the satellite itself and the processing center for ERTS photos. Data from ERTS, either real time or taped, is first sent through a video switching matrix which integrates signals from the three cameras, one scanner, the data collection system and spacecraft telemetry, and sends it to either of two frequency modulators. The data collection system is designed to relay data from remote stations to ground stations via ERTS. The procedure for processing 10,000 images a week is described. F.R.L.

A73-21593 Space applications. G. Lewis (British Aircraft Corp., Ltd., London, England). *Flight International*, vol. 103, Feb. 8, 1973, p. 199-201.

A review is made of what may be expected from the various types of applications satellites in the near and more distant future. Data obtained from the Applications Technology Satellites launched by NASA have been applied to the operational programs intended for future earth-survey, communications, and meteorological satellites. Particulars of ERTS-1 are given, and some results obtained are discussed. Attention is given to sounding rocket surveys. Problems for the future include handling, processing, and interpretation of data. Comsats, aerosats and maritime satellites, and weather research satellites are considered. F.R.L.

A73-25149 Weather satellite capabilities - Present and future. R. L. Pyle (NOAA, National Environmental Satellite Service, Washington, D.C.). *Weatherwise*, vol. 25, Oct. 1972, p. 209-219.

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Examples of some of the more noteworthy and spectacular cases among the diverse applications of weather satellite data are illustrated and discussed. These examples concern hurricanes, tornadoes, severe local storms, public weather forecasts, sea surface temperature, sea and lake ice, solar proton density, and some international aspects. Future plans are also briefly reviewed. M.V.E.

A73-26295 Study of terrestrial resources by space objects and international law (L'étude des ressources terrestres par des objets spatiaux et le droit international). M. G. Marcoff (Fribourg, Université, Fribourg, Switzerland). *Revue Générale de l'Air et de l'Espace*, vol. 35, no. 4, 1972, p. 343-348. 25 refs. In French.

The teleobservation and surveillance of the surface of the earth by satellite cannot limit itself solely to the geographical confines of the state or states which have authorized the activity, or who are participating in the experiments. In regard to risks of international disputes arising from space prospecting of terrestrial resources, even if carried out with the consent of certain states, and taking account of the contradictory interests of the economic and military establishments implied in this type of activity, it is to be hoped that the judicial subcommittee of the U.N. will not delay in initiating appropriate international procedures. F.R.L.

A73-27062 * # The American space program for the future. D. M. D. Wyatt (NASA, Washington, D.C.). *Istituto Internazionale delle Comunicazioni, Convegno Internazionale delle Comunicazioni*, 20th, Genoa, Italy, Oct. 8-13, 1972, Paper. 9 p.

A73-27951 # World participation in remote sensing from space. A. H. Aldred (Department of the Environment, Forest Management Institute, Ottawa, Canada). *International Society of Photogrammetry, International Congress for Photogrammetry*, 12th, Ottawa, Canada, July 24-Aug. 4, 1972, Paper. 24 p. 17 refs.

Some potentially useful means of acquiring and combining sources of remote sensing data are reviewed. Users should consider alternatives in cooperative and independent remote sensing programs. The present Canadian and Brazilian participation in ERTS illustrates a cooperative approach; some other alternatives show how relatively inexpensive programs can be developed independently. The main factors involved in planning such programs are reviewed in the context of data needs, accuracy requirements, and budgetary and other constraints. (Author)

A73-28786 # ERAF - Proposal for a European Earth Resources Aircraft. H. Langefeld and J. Schauenburg. *Dornier-Post* (English Edition), no. 1, 1973, p. 20-23.

The aim of the study was to define an earth resources aircraft which would serve ESRO as a test support facility for sensor development in future earth resources satellites, and would be available to earth resources exploration institutes. ERAF (Earth Resources Aircraft Facility) is expected to be of value in the fields of oceanology, ecology, geography, geology, and hydrology. Of various aircraft evaluated, the Breguet Atlantic 1150 proved to be the most suitable. F.R.L.

A73-32292 A guide to earth satellites. Edited by D. Fishlock. London, MacDonald and Co. (Publishers), Ltd.; New York, American Elsevier Publishing Co., Inc., 1971. 167 p. \$7.95.

Satellites in earth orbit which are designed to gather and relay information of many different kinds, e.g., telephone, TV, or digital, are discussed. Among their future uses may be manufacture in space of boron filaments and various kinds of crystals at low cost and with improved effectiveness. More effective ways of joining materials, and development of new alloys may be achieved. The technology of earth satellites is reviewed extensively. Satellites for communications and meteorological purposes, for study of earth resources, for navigation and research, and for military purposes are described in detail. Some advanced satellite concepts are examined. F.R.L.

A73-32544 # Apollo, Skylab and shuttle - The past, present, and future. G. E. Mueller (System Development Corp., Santa Monica, Calif.). *AIAA Student Journal*, vol. 11, Apr. 1973, p. 32-37.

The various aspects of the Skylab program are discussed and the experiments which will be carried out by the Skylab crews are reviewed. The importance of these experiments to the nations economics is demonstrated by a discussion of the earth's resources experiment and its impact on such fields as agriculture, forestry, ecology, geology, geography, geomorphology, meteorology, hydrology, hydrography, and oceanography. V.P.

A73-33126 Realism in environmental testing and control; Proceedings of the Nineteenth Annual Technical Meeting, Anaheim, Calif., April 2-5, 1973. Meeting sponsored by the Institute of Environmental Sciences. Mount Prospect, Ill., Institute of Environmental Sciences, 1973. 532 p. Members, \$15.; nonmembers, \$20.

The monitoring, simulation, and control of environmental variables are considered in papers dealing with laboratory tests of equipment designed to sustain various adverse effects, equipment standards and test procedures for ensuring human safety, and the assessment and management of the earth's resources. Topics considered include digital computer simulation of physical processes which are continuous functions of time, psychophysiological preparation of environmental stress experiments with humans, data acquisition and evaluation in studies of environmental pollution and resources management, test equipment and procedures in crash-survivability research, environmental considerations in the operation and planning of nuclear systems, the development and control of vibration and impact tests, and simulation of aerospace environments. T.M.

A73-34279 Monitoring earth's resources from space. D. J. Fink (GE Space Center, Valley Forge, Pa.). *Technology Review*, vol. 75, June 1973, p. 32-41.

On July 23, 1972, the first Earth Resources Technology Satellite, ERTS-1, was successfully orbited. The ERTS program represents the first space mission solely dedicated to the development of practical applications of space data toward better monitoring and managing the resources of the earth. The overall ERTS system consists of a satellite observatory with its unique sensors, and a ground data-handling system that operates the spacecraft and begins the processing of the sensor data received from the spacecraft. Applications of ERTS-1 imagery are discussed together with aspects of color creation, problems of orbit control, and the promise of future systems. G.R.

A73-34929 # Italian participation in the control of the terrestrial environment from space (Sulla partecipazione italiana al controllo dell'ambiente terrestre dello spazio). C. E. Cremona (Consiglio Superiore dell'Aviazione Civile, Rome, Italy) and G. M. Cremona (Compagnia Industriale Aerospaziale S.p.A., Rome, Italy). In: The control of the terrestrial environment from space: International collaboration, methods and technologies; International Conference on Space, 13th, Rome, Italy, March 22-24, 1973, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1973, p. 57, 59-67. In Italian.

Attempt to develop an organic plan for recording programmable earth atmosphere parameters from satellites in space. The basic parameters involved in controlling the terrestrial environment from space are reviewed, including the area covered by the readings, the nature of the readings, the frequency and duration of the readings, and the weight and volume of the equipment necessary. The use of a group of orbiting satellites, rather than a single satellite, is recommended for carrying out the required readings. These satellites would be relatively low-altitude, extraatmospheric satellites launched into orbit from the Salto di Quirra firing range. A.B.K.

A73-34930 # The use of remote sensing for the detection of natural resources - Definition of the platforms, technical-organizational considerations (L'uso del telerilevamento per l'individuazione delle risorse naturali - Definizione delle piattaforme, considerazioni tecnico-organizzative). G. Barresi and A. Fornò (Compagnia Industriale Aerospaziale S.p.A., Rome, Italy). In: The control of the terrestrial environment from space: International collaboration, methods and technologies; International Conference on Space, 13th, Rome, Italy, March 22-24, 1973, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1973, p. 75, 77-99. In Italian.

A73-34933 # Some practical applications of remote sensing from aircraft. P. Hartl, H. Helbig, and E. Krauth (Institute for Satellite Electronics, Oberpfaffenhofen, West Germany). In: The control of the terrestrial environment from space: International collaboration, methods and technologies; International Conference on Space, 13th, Rome, Italy, March 22-24, 1973, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1973, p. 129, 131-140.

From the various applications of remote sensing techniques three different types of examples are described. The first one concerns imaging of forestry and agricultural land by means of false color films. In this connection, emphasis is placed on a description of the picture processing. As a second example for remote sensing application several methods for water pollution detection are discussed. As a third example, recognition of archeological remains by remote sensing is demonstrated. (Author)

A73-34943 # Key technological challenges of the Earth Resources Technology Satellite program. I. S. Haas (General Electric Co., Space Div., Philadelphia, Pa.). In: The control of the terrestrial environment from space: International collaboration, methods and technologies; International Conference on Space, 13th, Rome, Italy, March 22-24, 1973, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1973, p. 237, 239-253.

Review of a selected number of technological challenges which have been met in the Earth Resources Technology Satellite (ERTS) program. The topics discussed concern orbit and coverage parameters, spectral characteristics, system performance, and photographic interpretation and information extraction. A detailed analysis is made of the response and resolution of the return beam vidicon camera and the multispectral scanner used in the ERTS-1 satellite. A.B.K.

A73-34947 # Preliminary results from Israeli ERTS-1 program. J. Otterman (Tel Aviv University, Tel Aviv, Israel). In: The control of the terrestrial environment from space: International collaboration, methods and technologies; International Conference on Space, 13th, Rome, Italy, March 22-24, 1973, Proceedings. Rome, Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1973, p. 285, 287-293. 9 refs.

In the fall of 1972, the imagery taken by the Multi Spectral Scanner of the ERTS-1 satellite, started to arrive in Israel. The arriving imagery has been the subject of analysis in a multidisciplinary research program. The preliminary results till January 1973 are described. These include studies of jet contrails observed over the eastern Mediterranean, and, in more detail, oceanic observations of which the most significant is the discovery of a seasonal giant eddy, or whirlpool, in the Bay of Suez, in the Red Sea. (Author)

A73-34952 # Problems and possibilities of earth resource satellite systems. G. K. C. Pardoe (Hawker Siddeley Dynamics, Ltd., Stevenage, Herts., England). In: The control of the terrestrial environment from space: International collaboration, methods and technologies; International Conference on Space, 13th, Rome, Italy, March 22-24, 1973, Proceedings. Rome,

Rassegna Internazionale Elettronica Nucleare ed Aerospaziale, 1973, p. 349, 351-358.

The technical aspects involved in the satellite survey are considered, taking into account the current performance of the ERTS satellite. Forestry has been particularly well served by the ERTS measurements obtained so far, with considerable success in classifying various types of trees. Organization and administration of earth resource satellite programmes are discussed, giving attention to the keen interest shown by the United Nations Organization to this aspect of space work. G.R.

A73-35626 Electrical engineering - Service to mankind; Proceedings of the Southeast Region 3 Conference, Louisville, Ky., April 30-May 2, 1973. Conference sponsored by the Institute of Electrical and Electronics Engineers, et al. New York, Institute of Electrical and Electronics Engineers, Inc., 1973. 681 p. Members, \$15.; nonmembers, \$20.

The sessions dealt with environmental problems, information theory, electromagnetic theory, technology applications to contemporary problems, radar and pattern signal analysis, antennas, control theory, and communications systems. Attention was given to nonlinear and time-varying systems, electronic circuits and instrumentation, biomedical engineering, lasers and optical systems, and electronic devices.

F.R.L.

A73-35631 * Spacecraft systems design trade-offs for the Earth Resources Technology Satellite. G. A. Branchflower (NASA, Goddard Space Flight Center, Greenbelt, Md.). In: Electrical engineering - Service to mankind; Proceedings of the Southeast Region 3 Conference, Louisville, Ky., April 30-May 2, 1973. New York, Institute of Electrical and Electronics Engineers, Inc., 1973, p. E-6-1 to E-6-7.

The Earth Resources Technology Satellite Program's use of flight proven hardware in the design of a satellite for earth sensor payload support and data handling is discussed. The use of an existing satellite as the building block around which additional support systems such as the orbit adjust system, the redundant wideband telemetry systems, the second regulated power system, and the quad redundant command system is analyzed. System performance seen in orbit vs design objectives are discussed to point up the success of the design approach chosen. Also discussed are the schedule and cost benefits derived from the use of previously developed hardware with additional subsystems as required to meet program requirements. (Author)

A73-35833 # Need for and aspects of a cooperative European earth resources program. J. Bodechtel (München, Universität, Munich, West Germany) and D. Davidts (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). COSPAR, Plenary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper. 15 p.

Based on national and European studies and investigations on earth resources survey from space the demands under European aspects are derived. The special environmental conditions and variety of the European continent and areas of European interest call for modified mission programs and the adaption of data evaluation on our requirements. (Author)

A73-35934 # The preparatory phase of the German Earth Resources program. A. E. Löffler (Gesellschaft für Weltraumforschung mbH, Porz-Wahn, West Germany). COSPAR, Plenary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper. 22 p. 9 refs.

The concept of the preparatory phase of the German Earth Resources program is reviewed and the different activities are described within this framework. The results of industrial studies sponsored by GfW are discussed with respect to the basic research and technology as required for the implementation of a successful earth resources program. (Author)

A73-36032 # EROS Program and ERTS-1 satellite applications to geophysical problems. W. D. Carter (U.S. Geological Survey, Washington, D.C.). *COSPAR, Plenary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper.* 16 p. 14 refs.

It is shown that the broad synoptic view provided by small-scale images of the Earth Resources Technology Satellite, ERTS-1, under uniform lighting conditions, has made it possible to map lineaments and other structural features over large areas. Near-infrared images which portray vegetation in light tones and soil moisture in dark tones have greatly facilitated the problem of distinguishing structural features in heavily vegetated regions. Regional and continental tectonic analysis and volcano monitoring are now possible on an operational basis, while earthquake monitoring still requires some modifications and additional instrumentation. V.P.

A73-36045 # Natural resources research and development in Lesotho using ERTS imagery. A. A. Jackson (University of Botswana, Lesotho and Swaziland, Roma, Lesotho) and P. H. Nixon (Department of Mines and Geology, Maseru, Lesotho). *COSPAR, Plenary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper.* 5 p.

Summary of experience gained in employing ERTS-1 satellite reconnaissance of Lesotho to manage natural resources in that country. The geological and agricultural aspects of Lesotho are discussed to provide insight into the type of information required from ERTS-1 imagery in helping to identify locations of mineral resources and to plan crop and range management. Early black and white imagery from ERTS-1 indicates that, although it may be possible to identify mineral resource areas and to monitor grazing potential, assessment of crop production is more difficult due to the small field size typical of underdeveloped countries. Further experiments are being carried out with color enhancement and density separation in order to simplify the interpretation of imagery. T.M.

A73-36151 # South African activities in earth surveys. O. G. Malan (National Physical Research Laboratory, Pretoria, Republic of South Africa). *COSPAR, Plenary Meeting, 16th, Konstanz, West Germany, May 23-June 5, 1973, Paper.* 10 p. 5 refs.

During 1972 the Republic of South Africa has actively become engaged in the application of space techniques for earth surveys: two South African proposals for participation in the ERTS-1 programme were accepted by NASA. The first of these is a multidisciplinary proposal for assessment of satellite imagery in national resource surveys and the second an attempt to monitor vegetation growth on mine dumps. The preliminary analyses of ERTS-1 imagery of South Africa have indicated that these data could play a vital role in accelerating and lowering the cost of national surveys of soil and terrain type, natural vegetation, geology, and regional land use.

(Author)

A73-36390 Teledetection of terrestrial resources by satellites (La télédétection des ressources terrestres par satellites). A. Tchernonog. *La Recherche Spatiale*, vol. 12, May-June 1973, p. 1-5. 18 refs. In French.

Teledetection is a group of methods making it possible to determine the nature or condition of objects situated on the surface of the earth, and to identify the phenomena which occur on this surface, or above or below it, by means of observations carried out from airborne platforms or satellites. The juridical regime applicable to satellites for teledetection of terrestrial resources is treated, indicating that there is a need for specific regulation of teledetection activities in accordance with international law. Aspects of the Earth Resources Technology Satellite (ERTS) are discussed. F.R.L.

A73-36424 The application of simulation to mission planning for communications and data relay satellites. C. B. Winn and P. Menemeyer (Colorado State University, Fort Collins, Colo.). In: *Systems and simulation in the service of society*. La Jolla, Calif., Simulation Councils, Inc. (Simulation Councils Proceedings Series. Volume 1, no. 2), 1971, p. 69-77. 14 refs.

A simplified method for mission planning for communications or data-relay satellites is presented. The method may be easily implemented on either an analog or digital computer and may be used, for example, for planning of experiments involving the Earth Resources Technology Satellites (ERTS A and B) or for designing a regional communications satellite system. As examples of its use, the method is applied to an avalanche reporting network utilizing ERTS-A and also to a regional communications satellite system for the Caribbean Islands of Jamaica, Barbados, Grenada, Trinidad, and Puerto Rico. (Author)

A73-36826 Summer Computer Simulation Conference, Montreal, Canada, July 17-19, 1973, Proceedings. Volumes 1 & 2. Conference sponsored by AIChE, AMS, ISA, SCS, and S.H.A.R.E. La Jolla, Calif., Society for Computer Simulation, Inc., 1973. Vol. 1, 529 p.; vol. 2, 698 p. Price of two volumes, \$20.

Papers concerning various aspects of modern computer simulation technology are included. Among the subjects covered are numerical solutions to partial differential equations; the application of the Ornstein-Uhlenbeck stochastic process in a stochastic disturbance environment, computer-generated real-time three-dimensional visual images; the Skylab Mission Simulator Facility; and a flight simulator for advanced aircraft. Further topics include real-time hybrid hardware-in-the-loop simulation of a homing missile, aerodynamically-controlled high-performance tactical missile simulation, hybrid computer computation of launch vehicle system requirements, and continuous simulation models for remote sensing in hydrology.

V.Z.

A73-36832 Skylab Mission Simulator Facility. P. J. Anderson, R. W. Borland, G. Saffioti, and S. L. Williamson (Singer Co., Simulation Products Div., Houston, Tex.). In: *Summer Computer Simulation Conference, Montreal, Canada, July 17-19, 1973, Proceedings. Volume 1.* La Jolla, Calif., Society for Computer Simulation, Inc., 1973, p. 219-247.

Description of the Skylab Mission Simulator Facility at the Johnson Space Center in Houston, Texas, which serves as the principal systems training device for the Skylab astronauts. The Simulator comprises (1) a crew station enclosure housing the orbital assembly control and display panels, (2) an Instructor Operator Station for up to six instructors to control and monitor a simulation exercise, (3) an Image Generation System providing the control and display panels with solar images, (4) a computer complex and associated peripheral equipment, and (5) a software package. Particular attention is given to the software package whose operating systems and real time programs represent the Skylab subsystems, the Solar and Earth Resource Experiments, and the Equations of Motion. The requirements of each major software program are defined. The assumptions and approximations of the respective mathematical models are discussed. V.Z.

A73-37708 Astronautical research 1971; Proceedings of the Twenty-second Congress, Brussels, Belgium, September 20-25, 1971. Congress sponsored by the International Astronautical Federation. Edited by L. G. Napolitano. Dordrecht, D. Reidel Publishing Co., 1973. 560 p. \$51.30.

Topics discussed include astrodynamics, fluid-mechanics aspects of space flight, bioastronautics, earth-to-orbit and orbit-to-orbit space transportation, space propulsion systems, stability of aerospace structures and strength of aerospace materials, telemetering and data management, earth resources satellites, and scientific spacecraft. In particular, studies are made of the inertial force fields generated by nutational motion of a spin-stabilized asymmetric satellite, hypersonic conic flow past a configuration of 'wing-body' type, methods of regenerating water from water-containing wastes in spacecraft life-support systems, imaging systems and remote sensor technology used in Nimbus and ERTS satellites, the management of fish and water resources with the aid of applications satellites, and a

modulation technique for determining the density field around a wedge with a finite leading-edge thickness.

A.B.K.

A73-37713 The role of applications satellites in the management of the human environment. P. A. Castruccio (IBM Corp., Federal Systems Div., Gaithersburg, Md.). In: Astronautical research 1971; Proceedings of the Twenty-second Congress, Brussels, Belgium, September 20-25, 1971. Dordrecht, D. Reidel Publishing Co., 1973, p. 403-417.

Review of a number of models of fish abundance and water resources, noting the potential contributions that remote sensing can add to their performance. A number of oceanographic variables that warrant inclusion as inputs in fishing forecast models are cited, some of which, it is noted, could be detected through the use of combined buoy/satellite systems. The ESSA 'block box' model for predicting how much water will be available in a watershed as a function of rainfall is described. The application of remote sensing techniques to the determination of the hydrologic regime of watersheds is discussed with a view toward improving the predictive accuracy of already instrumented and modeled watersheds and toward determining the hydrologic regimes of as yet unknown watersheds. A.B.K.

A73-38267 Earth studies from space and their legal problems (Die Erkundung der Erde aus dem Weltraum und ihre rechtlichen Probleme). M. Schroeder (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Abteilung extraterrestrische Sensortechnik, Oberpfaffenhofen, West Germany) and W. von Kries (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Porz-Wahn, West Germany). *DFVLR-Nachrichten*, July 1973, p. 421-425. In German.

The orbital data and instrument package of the ERTS-A (Earth Resources Technology Satellite) and its ground system are discussed. The legal aspects of studying the earth resources of sovereign countries out of space are considered. V.P.

A73-38386 Intersociety Energy Conversion Engineering Conference, 8th, University of Pennsylvania, Philadelphia, Pa., August 13-16, 1973, Proceedings and Addendum. Conference sponsored by AIAA, AIChE, ANS, ASME, IEEE, SAE, and ACS. New York, American Institute of Aeronautics and Astronautics, Inc., 1973. Proceedings, 854 p.; Addendum, 180 p. Members, \$50.; nonmembers, \$60.

The development of energy conversion systems is depicted in papers dealing with the operation, design, performance, materials, testing, and reliability of specific new and improved system concepts. Major topics covered include radioisotope thermoelectric generators, electrochemical power systems, solar power, biomedical power sources, nuclear energy, hydrogen fuel developments, Stirling cycle engines, aerospace power systems, and urban energy sources. Devices examined cover the wet Brayton cycle engine, Rankine cycle engines, the Wankel rotary engine, fuel cells, batteries, gas turbines, nuclear reactors, and utility systems for urban needs.

T.M.

A73-38435 # Low cost modular power systems for multi mission earth observations. A. Kirpich and J. Schumacher (General Electric Co., Philadelphia, Pa.). In: Intersociety Energy Conversion Engineering Conference, 8th, Philadelphia, Pa., August 13-16, 1973, Proceedings. Addendum. New York, American Institute of Aeronautics and Astronautics, Inc., 1973, p. 173-184.

Drawing on the experience gained with existing Nimbus and ERTS spacecraft power systems, improved power system configurations having higher efficiency and lower cost are developed. Basic power system requirements are first enumerated including orbit inclination and altitude constraints, and probable load profiles. From these factors and others relating to sensor viewing constraints, practical spacecraft configurations are developed which are commensurate with required array sizing.

Both fixed and oriented solar array versions are described, with the selection of one or the other based on the range of orbit beta angles that would be expected for a particular mission. A low-cost modular approach is described which could be adopted to either the fixed or oriented solar array versions.

(Author)

A73-38587 # Management looks at the Canadian program of remote sensing, phase I, 1971-1975. L. W. Morley (Department of Energy Mines and Resources, Canada Centre for Remote Sensing, Ottawa, Canada) and D. J. Clough (Waterloo, University, Waterloo, Ontario, Canada). *American Astronautical Society, Annual Meeting, 19th, Dallas, Tex., June 19-21, 1973, Paper 73-129*. 9 p.

The Canada Centre for Remote Sensing (CCRS) was established in February 1971. The CCRS forms the hub of a national program in remote sensing. The three main activities of the CCRS include the satellite program, the airborne program, and the applications development program. Multispectral imagery of Canada produced by the CCRS since ERTS-A was launched (July 1972) has provided striking evidence of the satellite's synoptic power. G.R.

A73-38588 # Contributions of the EROS Program to the Department of the Interior's resources and management responsibilities. W. A. Fischer (U.S. Geological Survey, Washington, D.C.). *American Astronautical Society, Annual Meeting, 19th, Dallas, Tex., June 19-21, 1973, Paper 73-130*. 13 p. 16 refs.

A73-39837 # Remote sensing and international affairs. B. Lundholm (Statens Naturvetenskapliga Forskningsrad, Stockholm, Sweden). In: International Symposium on Remote Sensing of Environment, 8th, Ann Arbor, Mich., October 2-6, 1972, Proceedings. Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1973, p. 191-198.

Remote sensing, a child of the space age, has been developed by the two space powers, the U.S. and the USSR, and only these two powers can, for the moment, make full use of the technique. One of the main functions of the Earth Watch is monitoring in order to identify and determine the extent of environmental problems of international importance. Monitoring of the biosphere, the atmosphere, the oceans, and the Arctic are discussed. Remote sensing has a role to play in environmental management and in the part of the UN action plan dealing with natural resources. It is pointed out that in relation to remote sensing a situation exists where the technical development is much more advanced than the political tools with which to handle this development. F.R.L.

N70-17026* # National Aeronautics and Space Administration, Washington, D.C. Scientific and Technical Information Div.

PROCEEDINGS OF THE WINTER STUDY ON USES OF MANNED SPACE FLIGHT, 1975-1985. VOLUME 2: APPENDICES

1969 177 p refs Conf. held at La Jolla, California, 6-9 Dec. 1968

(NASA-SP-196-Vol-2) Avail: CFSTI CSCL 22A

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3. THE LUNAR PROGRAM, APPENDIX C H. Hess and N. Hinners p 29-50 refs

4. ASTRONOMY, APPENDIX D L. Goldberg and D. Wood p 51-72 refs

5. SPACE PHYSICS, APPENDIX E L. Alvarez, J. Anderson, and L. Kaufman p 73-83 refs

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F. G. J. F. MacDonald, J. Whinnery, W. Thompson, and G. T. Orrok p 85-109 refs

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8. MATERIALS SCIENCE AND PROCESSING IN SPACE, APPENDIX H W. G. Shepherd and A. R. Vernon p 163-173 refs

N70-17032* National Aeronautics and Space Administration, Washington, D.C.

EARTH SCIENCES AND APPLICATIONS, APPENDIX F

Gordon J. F. MacDonald, John Whinnery, William Thompson, and G. T. Orrok *In its Proc. of the Winter Study on Uses of Manned Space-Flight, 1975-1985* 1969 p 85-109 refs

Avail: CFSTI CSCL 03B

The accomplishments, objectives, and requirements of an earth science program are presented. The objectives are stated as: (1) A more precise knowledge and understanding of man's environment on earth and the forces controlling it, for accurate short and long term forecasting, and eventual control of his environment. (2) A more precise knowledge, inventory, and use of the earth's resources, particularly those of the United States. (3) The extension of communications of all types to world-wide coverage. (4) The development and adoption of systems of navigation and traffic control to achieve safe, economical, and swift air and sea transportation at higher traffic densities. (5) The accurate location of geographic features. The accomplishments have been in communications, meteorology, and geodesy. The needs in Earth Sciences and application are seen to be in obtaining observational data in the heat budget of the earth surface and atmosphere for improving weather forecasting, and possible climate modification, in geology for earthquake prediction. F.O.S.

N70-17335* International Institute for Aerial Survey and Earth Sciences, Delft (Netherlands).

PROCEEDINGS OF THE ITC POST-CONGRESS SEMINAR

J. Kure, ed. and D. A. Tait, ed. Jul. 1969 201 p Held at Delft, 29 Jul. 2 Aug. 1968 *Its Ser. A No. 47*

Avail: CFSTI

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N70-18921* National Aeronautics and Space Council, Washington, D.C.

AERONAUTICS AND SPACE REPORT OF THE PRESIDENT TRANSMITTED TO THE CONGRESS, JANUARY 1970

Jan. 1970 111 p

Avail: SOD \$1.00

The scientific accomplishments in aeronautics and space programs are reported. The specific developments in the various government departments are discussed. Details are given for ground support systems, power supplies, launchings, tracking, communications, lunar exploration and aircraft safety. International cooperation, university research, and industrial activities are also presented. F.O.S.

N70-21091* Booz-Allen Applied Research, Inc., Bethesda, Md. **ECONOMIC VIABILITY OF A SATELLITE SURVEYING SYSTEM** Final Report

William E. Brockman 29 Dec. 1969 73 p refs

(Contract NASw-1674)

(NASA-CR-109080; Rept-9019-030-9) Avail: CFSTI CSCL 22B

NASA is constantly reassessing areas of space technology regarding their potential capabilities for conversion into a public or commercial operational system. The present study had the purpose of determining whether an operational system based on NAVAID geodetic satellite technology could compete successfully in the commercial land surveying market. Such a satellite system can be visualized as having three subsystems: first, the orbiting satellites that will produce a signal for the ground stations to receive; second, the ground station tracking network -- the permanent network that will determine the orbital position and orbital information of the satellite; and third, the portable instruments used by the ground surveyors to determine the geodetic positions on the ground using the satellites as the reference points. The recognized method for a commercial enterprise to assess the economic feasibility of a new product is to determine the existence and size of the market for the product. The present study determined what product could be sold to what group of potential users for what price and estimated the gross revenue to an enterprise operating the system. Author

N70-21123* Syracuse Univ., N.Y.

SOME DOMESTIC LEGAL PROBLEMS IN THE EARTH RESOURCE SATELLITE PROGRAM

George J. Alexander and James P. McDonald Oct. 1969 23 p refs *Its Working Paper No. 8*

(Grant NGL-33-022-090)

(NASA-CR-109191) Copyright. Avail: CFSTI CSCL 05D

Legally troublesome questions resulting from remote sensing by satellites are discussed. One of the aspects is the extent to which large corporations and conglomerates will have an advantage over smaller businesses. Legal difficulties in weather modifications and state laws concerning the ownership of the atmosphere and government liability for damage are discussed. Emphasis is placed on the rights of privacy. The advantages to demographic, social studies, and economic researchers and planners are outlined, but it is pointed out that a highly centralized data bank would, in effect, permit the establishment of complete dossiers on individuals. The effect of a clerical error or a release of information by a person or computer error, and the need of guidelines to protect the confidentiality of reports are stressed. Testimony of the House Committee on Government Operation is reviewed, and suggestions such as the use of cryptography are mentioned. It is felt that remote sensing data adds a new dimension to the invasion of privacy, especially since information will come from direct sources rather than reports, and it is questioned whether courts are suitably equipped to protect the individual's privacy. N.E.N.

N70-24246* National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

SOME PHOTOGRAPHIC RESULTS OF THE APOLLO 11 MISSION

Paul A. Larsen 27 Feb. 1970 91 p refs
(NASA-TM-X-64501) Avail: CFSTI CSCL 14E

The work reported was done for several reasons: (1) to show what types of photographs are available as a result of the Apollo 11 mission; (2) to give the best possible photographic description of the lunar terrain in the vicinity of Tranquility Base, and as many other areas of the lunar surface as possible, so that Lunar Roving Vehicle (LRV) mission planners, designers, and engineers can obtain a feel for several types of lunar terrain that may be encountered by the lunar roving vehicle; (3) to show some of the better pictures as single photographs, stereograms, constructed panoramic views, sequence strips, and mosaics; (4) to demonstrate the feasibility of making certain elevation measurements of lunar topographical features, by using lunar photographs, photogrammetric techniques, and locally available photogrammetric equipment; and (5) to provide a reminder of the value of high altitude earth photography for earth resources studies. The 1405 photographs taken during the Apollo 11 mission were reviewed. Of this number, 104 were judged to be of sufficient interest for this study, and to warrant further analysis. Consequently, 27 stereograms, 9 panoramic views, one sequence strip, one mosaic, and 17 single photographs are included in this report, together with pertinent interpretations of the photographic data. Author

N70-25153# European Space Research Organization, Paris (France).

ESRO/ELDO BULLETIN, NO. 8

Jan. 1970 28 p refs Partly in ENGLISH and partly in FRENCH
Prepared jointly with ELDO
Avail: CFSTI

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1. THE ELDO EQUATORIAL BASE D. Bagaria p 4-10
2. NASA'S FUTURE PLANS AND PROGRAMS. T. O. Paine (NASA, Washington) p 12-16
3. PROGRESS IN OPERATIONAL PROGRAMME p 17-21

N70-25155*# National Aeronautics and Space Administration, Washington, D.C.

NASA'S FUTURE PLANS AND PROGRAMS

T. O. Paine In ESRO ESRO/ELDO Bull., No. 8 Jan. 1970 p 12-16 Presented at the European Space Conf. Comm. of Senior Offic., Paris, 14 Oct. 1969

Avail: CFSTI

The future major trends of NASA programs in the second decade of space activities are described. The hope was expressed that international cooperation in space activities between the USA and European countries would increase during that period. Future NASA programs emphasize the space shuttle and orbital space station projects, and nuclear propulsion for launch vehicles was also mentioned. Among scientific programs are orbital telescopes, planetary manned exploration, and flyby missions. Applications programs such as communication, meteorological, and navigation satellites, as well as Earth resources survey missions will also be further developed. ESRO

N70-26131*# Massachusetts Inst. of Tech., Cambridge.
INTERACTION WITH OTHER DISCIPLINES AND PROGRAMS

In its The Terrestrial Environ. Apr. 1970 12 p

Avail: CFSTI

Methods of establishing a geodetic reference frame are discussed, and it is recommended that NASA plan to unify the various satellite geodetic networks. The interrelationships between several NASA programs are delineated, with particular reference to the Earth Observation Program, the Earth Physics Program, and the Earth Resources Survey Program. The need for greater accuracy

in orbit determination and navigation is stressed. The importance of interagency cooperation and participation, and of international cooperation is emphasized. M.G.J.

N70-26132*# Massachusetts Inst. of Tech., Cambridge.

DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

In its The Terrestrial Environ. Apr. 1970

14 p refs

Avail: CFSTI CSCL 08F

The areas of potential social benefit from a Solid Earth and Ocean Physics Program are identified as material resources, environmental quality, technological capability, and intellectual capability. Priorities are given to certain improvements in understanding or capability as scientific goals toward which recommended programs should be directed. Recommendations are placed in two priority-ordered lists of decision elements (the minimal blocks of research, development, and fabrication that should be undertaken to realize a particular measurement capability). These two lists correspond to two levels of feasibility: immediate, for which fabrication of the necessary instrumentation could be undertaken at once; and eventual, in which the items appear technically feasible, but which require appreciable development to attain the desired accuracies, resolutions, and lifetimes. Author

N70-26798# Congress. House. Committee on Science and Astronautics.

EARTH RESOURCES SATELLITE SYSTEM

Joseph E. Karth Washington GPO 1969 31 p ref Presented to the Comm. on Sci. and Astronaut., 91st Congr., 2d Sess., 31 Dec. 1968 /ts Serial W

Avail: Subcomm. on NASA Oversight

The feasibility of an earth resources satellite system is reported by reviewing the existing technological base for remote sensing in satellite systems. The uses of this data in cartography, agriculture and forestry, oceanography, geology, and hydrology are discussed. It is recommended: (1) that NASA concentrate a much larger portion of its efforts and resources on this project, and (2) the use of automated spacecraft instead of manned systems. F.O.S.

N70-26981*# National Aeronautics and Space Administration, Washington, D.C.

ECOLOGICAL SURVEYS FROM SPACE

1970 80 p refs

(NASA-SP-230) Avail: SOD \$1.75. CFSTI CSCL 08F

The use of spacecraft for earth resources surveys is discussed for seven different disciplines, which include geography, agriculture, forestry, geology, hydrology, oceanography, and cartography. Photographs taken with different filters and types of film from the Gemini and Apollo flights illustrate the man-made changes of the earth's surface as well as natural resources. R.B.

N70-27083*# Radiometric Technology, Inc., Cambridge, Mass.

AN ANALYSIS OF AIRBORNE MICROWAVE RADIOMETRIC DATA Final Report

7 Feb. 1970 130 p refs

(Contract NAS5-11685)

(NASA-CR-109846) Avail: CFSTI CSCL 04B

Data from measurements taken in 1967, 1968, and 1969 over ocean and land areas by a 19.35 GHz phased-array scanner aboard the NASA Convair 990 are analyzed. Of particular interest are data which relate to the radiation emitted and affected by clouds. Other data from sensors measuring energy at IR wavelengths, temperature in situ, and, for the flights in 1969, energy at 9.3 GHz, are utilized to reconstruct atmospheric, surface, and cloud characteristics. Theoretical brightness temperatures derived from cloud models, consistent with the physical data available, are in general agreement with the brightness temperatures observed over ocean areas. Although a somewhat limited effect is evidenced by clouds over dry bare soil and vegetation areas, a reasonably pronounced effect appears possible over moist soils. Analysis of

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those cases in which computed brightness temperatures do not match the observed brightness temperatures indicates either: (1) the existence of cloud droplets larger than can be treated successfully by the simple Rayleigh theory utilized; or (2) the incompleteness of the cloud models themselves. Author

N70-27272# Joint Publications Research Service, Washington, D.C.

INHABITED ORBITAL STATIONS

V. Volkov 13 May 1970 9 p Transl. into ENGLISH from Sots. Industriya (Moscow), 12 Apr. 1970 p 4 (JPRS-50511) Avail: CFSTI

The use of manned orbital laboratories is proposed for monitoring natural resources and weather forecasting. R.B.

N70-27747*# Bellcomm, Inc., Washington, D.C.

PHOTOGRAPHY OF GROUND SITES FROM AAP ORBIT

D. A. DeGraaf and E. W. Radany 12 Feb. 1970 43 p

(Contract NASw-417)

(NASA-CR-109772; B70-02023) Avail: CFSTI CSCL 14E

The possibility of remaining in the solar-inertial attitude during the ground photography is explored. The existence of an adequate window in the MDA on the side way from the ATM so that the center of its field is always directly along the sun's rays is presumed. Targets outside this field of view are not well lit and were not photographed. Emphasis is placed on the orbit geometry and calculation of the viewing opportunities. Other topics discussed are optical distortions due to the window that must be guarded against and improvements in the operational procedures that would accrue from this alternate method. Author

N70-28671*# National Aeronautics and Space Administration, Washington, D.C.

RIGHTS IN DATA CLAUSES AND THEIR IMPACT ON INFORMATION FUNCTIONS OF GOVERNMENT

Garland T. Mc Coy 23 Mar. 1970 22 p Presented at 2nd Natl. Meeting of the Inform. Ind. Assoc.

(NASA-TM-X-62929) Avail: CFSTI CSCL 05B

Government policies regarding information acquisition and dissemination are discussed with emphasis on data rights problems relating to computer software. Rights in data policies governing NASA and DOD are summarized. Mention is given to AEC and HEW policy restrictions, acts for contractors protection, and data rights problems resulting from earth resource satellite operations. S.S.

N70-30675# Joint Publications Research Service, Washington, D.C.

SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 228

13 May 1970 89 p Transl. into ENGLISH from Russian periodicals (JPRS-50505) Avail: CFSTI

CONTENTS:

1. ASTRONOMY p 1-6
2. METEOROLOGY p 7-22
3. OCEANOGRAPHY p 23-31

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4. TERRESTRIAL GEOPHYSICS p 32-50

5. UPPER ATMOSPHERE AND SPACE RESEARCH p 51-78

N70-31579*# National Aeronautics and Space Administration, Washington, D.C.

SPACE STATION: KEY TO THE FUTURE

[1970] 42 p

(NASA-EP-75) Avail: SOD \$0.45; CFSTI CSCL 22B

The Space Station and some of its future benefits are described in nontechnical terms taken from information that has been presented at technical conferences. Possible benefits are: (1) detection of large-scale dynamic earth phenomena such as changes in snow pack, air and water pollution, and occurrences in remote areas; (2) maintenance of meteorological satellites; (3) prospecting for mineral resources; (4) crop condition identification; and (5) locating areas of subterranean water sources. Space station configurations and crew requirements are discussed. F.O.S.

N70-34409*# TRW Systems Group, Redondo Beach, Calif.

EARTH RESOURCES TECHNOLOGY SATELLITE. VOLUME

1: SUMMARY Final Report

17 Apr. 1970 111 p

(Contract NAS5-11260)

(NASA-CR-109913) Avail: CFSTI CSCL 22B

An overall description of the development of the Earth Resources Technology Satellite is presented, including the observatory, ground data handling system, and the data collection system. Performance requirements and performance achievements are summarized. A list of study tasks and results is included. F.O.S.

N70-34412*# TRW Systems Group, Redondo Beach, Calif.

EARTH RESOURCES TECHNOLOGY SATELLITE. VOLUME

4: OBSERVATORY SUBSYSTEMS STUDY Final Report

11 Feb. 1970 529 p refs

(Contract NAS5-11260)

(NASA-CR-109917) Avail: CFSTI CSCL 22B

The application of the OGO technology to the development of an ERTS vehicle is discussed in terms of the verification of the applicability of existing items or techniques, modifications when required, and the development of new equipment. The functions that required new or modified equipment are listed. The spacecraft subsystems are analyzed. F.O.S.

N70-34414*# TRW Systems Group, Redondo Beach, Calif.

EARTH RESOURCES TECHNOLOGY SATELLITE. VOLUME

6: RELIABILITY PROGRAM PLAN Final Report

17 Apr. 1970 88 p refs

(Contract NAS5-11260)

(NASA-CR-109842) Avail: CFSTI CSCL 22B

The OGO reliability program was revised to meet the ERTS requirements. The plan covers all aspects of reliability for the ERTS phase D contract. Author

N70-34415*# TRW Systems Group, Redondo Beach, Calif.

EARTH RESOURCES TECHNOLOGY SATELLITE. VOLUME

7: QUALITY PROGRAM PLAN Final Report

17 Apr. 1970 172 p

(Contract NAS5-11260)

(NASA-CR-109920) Avail: CFSTI CSCL 22B

This quality program plan sets forth the quality program requirements for the ERTS project and includes both the observatory and ground data handling systems. It defines the requirements for the effective implementation of a quality program. Author

N70-34416*# TRW Systems Group, Redondo Beach, Calif.

EARTH RESOURCES TECHNOLOGY SATELLITE. VOLUME

8: TEST MONITORING AND CONTROL PLAN Final Report

17 Apr. 1970 34 p

(Contract NAS5-11260)

(NASA-CR-109926) Avail: CFSTI CSCL 22B

This plan defines the management and implementation of the test monitoring and control effort. The plan is applicable to the observatory data collection and ground data handling system and related software. Author

N70-34419*# TRW Systems Group, Redondo Beach, Calif.
EARTH RESOURCES TECHNOLOGY SATELLITES. VOLUME 11: FAILURE REPORTING PLAN Final Report

17 Apr. 1970 35 p
 (Contract NAS5-11260)

(NASA-CR-109925) Avail: CFSTI CSCL 22B

Hardware and software experience gained through comprehensive failure reporting and analysis is utilized, and the corrective action to ensure that the probability of failure recurrence is reduced to acceptable levels is examined. Divisional and software failure controls are also reviewed. J.A.M.

N70-34420*# TRW Systems Group, Redondo Beach, Calif.
EARTH RESOURCES TECHNOLOGY SATELLITES. VOLUME 12: OBSERVATORY INTEGRATION AND TEST PLAN AND LAUNCH OPERATIONS PLAN Final Report

11 Feb. 1970 81 p refs

(Contract NAS5-11260)

(NASA-CR-109927) Avail: CFSTI CSCL 22B

Subsystem level tests, payload integration and test, pre-environmental and post-environmental tests, final payload, spacecraft tests, and alignment checks prior to shipment to the launch site are outlined. Test management procedures, test equipment, and facilities planned for implementation of the test program are summarized. A building block philosophy is utilized during integration of subsystem assemblies into the spacecraft which, coupled with methodical testing and monitoring, assured mutual compatibility and proper operation of each subsystem. The launch readiness review, launch site activation, and launch operations are discussed, along with flight worthiness of the spacecraft documented during the launch readiness review. J.A.M.

N70-34421*# TRW Systems Group, Redondo Beach, Calif.
EARTH RESOURCES TECHNOLOGY SATELLITE. VOLUME 13: GDHS STAFFING AND MATERIAL USAGE PLAN Final Report

17 Apr. 1970 79 p refs

(Contract NAS5-11260)

(NASA-CR-109919) Avail: CFSTI CSCL 22B

The personnel requirements analyses, resultant staffing requirements, and material usage requirements are presented for the ERTS Ground Data Handling System. A description of the positions required, the manning requirements, the training program, and the technical manuals are also included. A manpower cost estimate for the operation and maintenance of the GDHS is also provided. The staffing requirements are based upon three separate work areas which functionally segregate the GDHS equipment and work stations into the Operation Control Center, the NASA Data Processing Facility, and the Automatic Data Processing Equipment of the NDPF. Items required to set-up operations and expendables consumed in one year of operation are tabulated for the OCC, the ADPE, and Image and Photo Processing. Author

N70-34425*# TRW Systems Group, Redondo Beach, Calif.
EARTH RESOURCES TECHNOLOGY SATELLITE. VOLUME 15 APPENDIX: FUNCTIONAL ANALYSIS

17 Apr. 1970 168 p

(Contract NAS5-11260)

(NASA-CR-109914) Avail: CFSTI CSCL 22B

The functional flow diagrams and the requirements allocation sheets for the ERTS operations control and data processing are presented. Author

N70-34426*# TRW Systems Group, Redondo Beach, Calif.
EARTH RESOURCES TECHNOLOGY SATELLITE. VOLUME 16: OPERATIONS CONTROL CENTER STUDIES Final Report

17 Apr. 1970 211 p

(Contract NAS5-11260)

(NASA-CR-109915) Avail: CFSTI CSCL 22B

Equipment requirements for an Operations Control Center for a spacecraft such as ERTS were investigated. The specific design of a center is based on the characteristics of the orbit, the spacecraft, the payload, and ground stations. The data collection and the spacecraft command systems are discussed. Training, simulation, and scheduling problems are outlined. S.S.

N70-34455*# General Electric Co., Philadelphia, Pa. Space Systems Organization.

EARTH RESOURCES TECHNOLOGY SATELLITE SPACECRAFT SYSTEM DESIGN STUDIES. VOLUME 2, BOOK 1: SUBSYSTEMS STUDIES Final Report

11 Feb. 1970 703 p

(Contract NAS5-11529)

(NASA-CR-109837; Doc-70SD4207-Vol 2-BK-1) Avail: CFSTI HC\$10.00/MF\$0.65

The development of an observatory spacecraft capable of meeting the requirements of the ERTS mission is studied with emphasis on communications and data handling, image location requirements and sensors, electrical integration, thermal control and payload integration. The design constraints, and spacecraft baseline design are given. F.O.S.

N70-34456*# General Electric Co., Philadelphia, Pa. Space Systems Organization.

EARTH RESOURCES TECHNOLOGY SATELLITE SPACECRAFT SYSTEM DESIGN STUDIES. VOLUME 2, BOOK 2: SUBSYSTEMS STUDIES Final Report

11 Feb. 1970 563 p

(Contract NAS5-11529)

(NASA-CR-109908; Doc-70SD4207-VOL-2-BK-2) Avail: CFSTI HC\$10.00/MF\$0.65 CSCL 22B

The Attitude Control Subsystem recommended for the Earth Resources Technology Satellite is an updated and slightly modified version of the flight qualified Nimbus D stabilization subsystem. Because of differences in mission, orbit, attitude control requirements, etc., the Nimbus stabilization subsystem cannot be used directly, but must be modified to meet the particular requirements of the ERTS mission. The specific areas requiring analysis and evaluation of the Attitude Control Subsystem were identified, the analyses performed, and the necessary modifications to the attitude control subsystem specified. The proposed ERTS stabilization subsystem and the modifications to the stabilization subsystem to meet the ERTS requirements are presented with descriptions of the orbit adjust subsystem, a thermal control subsystem, and the power subsystem. The electrical integration subsystem includes the distribution harness and the preflight disconnect, power switching module. Electromagnetic interface considerations, integration, test and launch support equipment, as well as mechanical equipment are included. S.S.

N70-34457*# General Electric Co., Philadelphia, Pa. Space Systems Organization.

EARTH RESOURCES TECHNOLOGY SATELLITE SPACECRAFT SYSTEM DESIGN STUDIES. VOLUME 3: PERFORMANCE ASSURANCE Final Report

11 Feb. 1970 204 p

(Contract NAS5-11529)

(NASA-CR-109906; Doc-70SD4207-Vol-3)

Avail: CFSTI CSCL 22B

The performance assurance plans for obtaining high spacecraft performance, reliability, and workmanship are presented. The design/development phase, procurement/fabrication phase, and test phase activities are discussed. These include the quality program plan for ERTS A and B, parts plan, materials and processes, configuration management plan, process establishment and control, failure analysis and reporting, compliance of existing hardware to ERTS requirements, and reliability program plan. N.E.N.

09 GENERAL

N70-36162# Congress. house. Committee on Science and Astronautics.

SUPPLEMENTAL REVIEW: NASA-OSSA PROJECTS

Washington GPO 1969 40 p Hearings before Comm. on Sci. and Astronaut., 91st Congr., 1st Sess., No. 9, 16 Oct. 1969

Avail: Subcomm. on Space Sci. and Appl.

Congressional testimony is reported on the status of the Viking, ERTS, and the ATS programs. Cost estimates for the programs are discussed and changes made in the mission requirements are presented. R.B.

N70-41047*# Informatics Tisco, Inc., College Park, Md.

REMOTE SENSING OF EARTH RESOURCES. A LITERATURE SURVEY WITH INDEXES

Washington NASA 1970 1220 p Sponsored by NASA

(NASA-SP-7036) Avail: NTIS HC\$10.00/MF\$0.65 CSCL08F

This literature survey lists 3684 reports, articles, and other documents introduced into the NASA scientific and technical information system between January 1962 and February 1970. Emphasis is placed on the use of remote sensing and geophysical instrumentation in spacecraft and aircraft to survey and inventory natural resources and urban areas. Subject matter is grouped according to agriculture and forestry, environmental changes and cultural resources, geodesy and cartography, geology and mineral resources, oceanography and marine resources, hydrology and water management, data processing and distribution systems, instrumentation and sensors, and economic analysis. Author

N70-41148*# Geological Survey, Washington, D.C.

SUMMARY OF SIGNIFICANT RESULTS OF REMOTE SENSING STUDIES IN 1965

W. D. Carter May 1966 21 p refs *Its Tech. Letter* NASA-14

(NASA Order R-09-020-013)

(NASA-CR-75462) Avail: NTIS CSCL08G

The feasibility and applications of remote sensing devices mounted in earth orbiting spacecraft are being investigated as tools to study the geology, hydrology, geography, cartography, oceanography, agriculture, and forestry of the earth. Some of the significant results of these studies are summarized, which include analysis of black and white, color, near infrared, and multiband photography; and radar and infrared imagery from sites with varied geologic features. Results of studies on hydrologic, cartographic, and geographic applications of remote sensing data are also included. R.N.A.

N70-42766# Transportation Systems Center, Cambridge, Mass. **EARTH SURVEY BIBLIOGRAPHY: A KWIC INDEX OF REMOTE SENSING INFORMATION**

William I. Thompson, III Sep. 1970 269 p refs

Avail: Issuing Activity

A bibliography of citations pertaining to the Earth Resources Program is presented. The scope ranges from detailed discussions on the politics of earth survey operations to selection of film used for aerial surveys. The bibliography is intended as a source document leading quickly to specific information and sources of additional information. Author

N71-10806*# Auburn Univ., Ala. School of Engineering.

UNISTAR: USER NETWORK FOR INFORMATION STORAGE, TRANSFER, ACQUISITION, AND RETRIEVAL Final Report

Oct. 1970 312 p refs Sponsored in part by the Am. Soc. for Eng. Educ.

(Grant NGT-01-003-044)

(NASA-CR-61333) Avail: NTIS CSCL05B

The UNISTAR is an information management system (IMS) for scientific and technological information under the executive branch of the United States Government developed during a training exercise in the systems approach. This study indicates that: (1) A

national policy on the goals and purposes of an information management system (IMS) must be established. (2) The National Aeronautics and Space Administration is in a unique position to provide leadership to develop an IMS for space-related data. (3) A useful IMS should assume an active as well as the usual passive role in handling information. Depositories, such as libraries, perform a passive role in the management of information in that the user must ask for information before it is forthcoming. It should be possible to actively encourage users to take advantage of the available information. (4) Equal emphasis should be placed on seeing that the educational community is well served by an active IMS. Author

N71-12199*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

EARTH RESOURCES RESEARCH DATA FACILITY INDEX

Jul. 1970 419 p refs Revised

(NASA-TM-X-66487; MSC-02576-Rev) Avail: NTIS CSCL08E

The cumulative issue of the Earth Resources Research Data Facility (ERRDF) Index is presented. All Earth Resources Program information and related data that is available at the National Aeronautics and Space Administration's Manned Spacecraft Center are listed. Included in the Index are data collected during flights over test sites and from studies made by investigators supporting the Earth Resources Survey Program. The information is cataloged into four major categories as follows: (1) technical documents and maps, (2) functional and check out data, (3) imagery data, and (4) electronic data. Author

N71-12420# National Aeronautics and Space Administration, Washington, D.C.

AMERICA'S NEXT DECADES IN SPACE A Report for the Space Task Group

Sep. 1969 88 p

(NASA-TM-X-66499) Avail: NTIS CSCL22A

A space program is outlined which was designed to provide a continuing output of benefits in practical applications, science, and technology and simultaneously the development of new and improved capabilities required for the exploration of the solar system. The major elements of the proposed civilian space program include the early development and operation of a permanent manned station in near-earth orbit to provide experience on long-duration manned flight, practical benefits through observation of the earth and its environment, and scientific research. Further recommendations include: (1) the design of a new and truly low-cost space transportation system as an integral part of the space station concept; (2) planetary exploration with continuing missions to the near planets followed by missions to Jupiter and outer planets; and (3) sustained efforts to develop means for more effective control of our environment and management of our resources, as well as new services in communications, navigation, and air traffic control. D.L.G.

N71-12566*# National Aeronautics and Space Administration, Washington, D.C.

THIS ISLAND EARTH

Oran W. Nicks, ed. Oct. 1970 192 p

(NASA-SP-250) Avail: SOD \$6.00; NTIS CSCL08F

Photographs taken from satellites and manned spacecraft are presented and discussed in order that man may better understand his place in the universe. The emphasis is on the earth and its atmosphere, waters, lands, and man-made features. Detailed pictures are given of North American mountains, plains, and coasts. Photographs are also included of the sun, planets, and moon. N.E.N.

N71-13094*# Northwestern Univ., Evanston, Ill. Dept. of Geological Sciences.

STATISTICAL EVALUATION OF THE COMPOSITION, PHYSICAL PROPERTIES, AND SURFACE CONFIGURATION OF TERRESTRIAL TEST SITES AND THEIR CORRELATION

WITH REMOTELY SENSED DATA Final Report

E. H. Timothy Whitten and Walter A. Beckman, Jr. 7 Oct. 1970
21 p refs

(Grant NGR-14-007-027)

(NASA-CR-111568; Rept-24) Avail: NTIS CSCL08G

A review of the project is presented which includes a list of reports issued, published articles, and statistical methods used in the remote-sensing program. The work, utilizing spatial filtering for analyzing the structural configuration of the top of the Dundee Limestone in the Michigan Basin is described. Maps prepared by polynomial, Fourier series, and filtered structural contours from numerical analysis of two-different sets of data are shown. F.O.S

N71-14426* National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.

FUTURE FIELDS OF CONTROL APPLICATION

Aug. 1969 151 p refs Symp. held at Cambridge, Mass., 10-11 Feb. 1969

(NASA-TM-X-66516; PM-87) Avail: NTIS CSCL05A

CONTENTS:

1. POSSIBLE AREAS OF CONTROL THEORY IN PRINT COMMUNICATION J. L. Hallenbeck (Time, Inc.) p 3-13

2. DISCUSSION OF HALLENBECK PAPER H. M. Paynter (MIT, Cambridge) p 15-22

3. BIOLOGICAL CYBERNETICS L. Stark (Calif. Univ., Berkeley) p 23-38

4. AIR TRANSPORTATION R. F. Lambert (Am. Airlines, Inc., N.Y.) p 39-53

5. URBAN STUDIES: AN OPPORTUNITY FOR SYSTEMS ENGINEERING J. E. Gibson (Oakland Univ.) p 55-65 refs

6. WORLD BANK OPERATIONS IN THE LESS-DEVELOPED COUNTRIES I. S. Friedman (Intern. Bank for Reconstruction and Develop.) p 67-86

7. DISCUSSION OF FRIEDMAN PAPER Y.-C. Ho (Harvard Univ., Cambridge, Mass.) p 87-97 ref

8. CONTROL TECHNOLOGY APPLIED TO PRODUCTION PROBLEMS C. V. Foster (Continental Oil Co.) p 99-110 refs

9. DISCUSSION OF FOSTER PAPER T. J. Williams (Purdue Univ.) p 111-119

10. BIOLOGICAL OCEANOGRAPHY G. C. Ewing (Woods Hole Oceanog. Inst.) p 121-133

11. REFLECTIONS ON GIFFORD EWING'S PAPER J. V. Breakwell (Stanford Univ.) p 135-136

12. HOW DO WE MEET FUTURE CONTROL CHALLENGES? L. A. Zadeh (Calif. Univ., Berkeley) p 137-146

N71-14846* Washington State Dept. of Natural Resources. Olympia.

EARTH RESOURCES OBSERVATION SATELLITE IMAGE UTILITY AT STATE LEVEL Final Report

David W. Jamison Apr. 1970 158 p refs

(Contract DI-14-08-0001-G-21)

(PB-193859; USGS-DO-70-003) Avail: NTIS CSCL08B

The utility of the proposed EROS program as an information source for operational state agencies and academic institutions has been explored within the State of Washington. Personnel from natural resources and land use oriented state agencies participated. Research personnel from the University of Washington and Washington State University carried out studies of the imagery. High altitude, small scale photographs, both singly and in mosaic form, were used to simulate ERTS imagery. Participants were asked to relate their data needs to the proposed ERTS imagery and the timeliness of satellite surveillance. Resulting evaluation lead to the following conclusions; significant data use of ERTS imagery can occur at the state level; potential user knowledge of the availability

of aerial photography and how to use it is poor; ERTS imagery simulation process used in this study was poor; and satellite relay ground sensor data would be of significance to many users.

Author (USGRDR)

N71-14916* La Plata Univ. (Argentina). Asociacion Argentina de Ciencias Aerospaciales.

FIRST SYMPOSIUM ON THE APPLICATION OF REMOTE SENSORS TO DETERMINING, CONSERVING AND UNDERSTANDING OF NATURAL RESOURCES [PRIMERIO SIMPOSIO SOBRE: APLICACION DE SENSORES REMOTOS PARA DETERMINACION, CONSERVACION Y DESARROLLO DE RECURSOS NATURALES]

[1969] 125 p refs Conf. held at La Plata, 13-15 Oct. 1969 In SPANISH

Avail: NTIS

The objectives of the investigation of natural resources in agriculture, forestry, oceanography, hydrology, geology, geography, and cartography are listed. Multiband imaging techniques from Apollo 9 are analyzed in terms of film and filters. Particular areas of investigation for remote sensors are air pollution, ocean pollution, and weather forecasting. The types of data required for each of these areas are tabulated.

Transl. by F.O.S.

N71-15409* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

PHOTOGRAMMETRIC TECHNIQUES APPLICABLE TO EARTH RESOURCES ANALYSES

Paul A. Larsen 21 Aug. 1970 65 p refs

(NASA-TM-X-64546) Avail: NTIS CSCL08B

The uses of photogrammetry as a tool for studying our natural resources and as an aid in understanding and defining environmental problems confronting the inhabitants of earth are discussed. Numerous applications of photogrammetry from the past are cited, and several very recent applications are discussed briefly, the intent being to help researchers and engineers in related fields see photogrammetry as an aid in their endeavors. Actual measurements of physical features of the earth's and moon's surfaces, which were made photogrammetrically on stereograms prepared from Apollo 6 and Apollo 8 vertical orbital photographs, are shown. The Skylab Experiment S-190, Six Camera Multispectral Photography, is discussed, and a graphical analysis dealing with the percentage of ground observable by the Skylab cameras as a function of cumulus cloud coverage is presented. The science of photogrammetry has proved to be an exceedingly useful and practical tool in the past, and all indications are that its applicability to life's current and future problems and tasks is just being discovered.

Author

N71-15461* Army Engineer Topographic Labs., Fort Belvoir, Va.

A MATHEMATICAL ANALYSIS OF THE PROPAGATION AND REFLECTION OF PLANE ELECTROMAGNETIC WAVES IN A NONHOMOGENEOUS ISOTROPIC MEDIUM

Richard A. Hevenor 1970 13 p refs

(AD-713539) Avail: NTIS CSCL 20/14

Considerable work has been accomplished in the area of analyzing the reflection and refraction of plane electromagnetic waves at a plane surface boundary, where the electrical parameters of the mediums under investigation are constants. In the area of Military Geographic Intelligence there exists a need to determine terrain surface and subsurface phenomena by the use of remote sensors. There is also a need to understand the consequence of nonhomogeneous soil mediums on the return energy going to a remote sensor such as a side looking airborne radar system. These needs can be fulfilled efficiently only when an understanding of the propagation and reflection of electromagnetic waves from natural terrain surfaces has been achieved. The understanding can be aided by solving the vector wave equation for the case where the soil conductivity and dielectric constant are functions of soil depth.

Author (TAB)

09 GENERAL

N71-15694* National Aeronautics and Space Administration, Washington, D.C.

EARTH OBSERVATIONS PROGRAM REVIEW, 4-5 NOVEMBER 1969

5 Nov. 1969 95 p

(NASA-TM-X-66568) Avail: Available to NASA Offices and Centers from the NASA Facility. All other requests for the document must be forwarded to Earth Observations Div., Code SR, NASA Headquarters, Wash., D.C. 20546 CSCL08E

Current programs are reviewed and possibilities developed for the survey of earth resources and monitoring weather. Supporting research and technology contributing to the advancement and applications of these programs are discussed. Author

N71-16126*# National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.

EARTH RESOURCES AIRCRAFT PROGRAM STATUS REVIEW. VOLUME 1: GEOLOGY, GEOGRAPHY, AND SENSOR STUDIES

1968 571 p refs Conf. held at Houston, Tex., 16-18 Sep. 1968

(NASA-TM-X-62564) Avail: NTIS CSCL08F

Reviewed are the various aspects of aerial remote sensors and multispectral imagery of the Earth Resources Program as applied to the areas of geology, geography, and urban planning. Emphasized imaging systems constitute black and white photography, color photography, infrared imagery, and radar imagery.

N71-16166*# National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.

EARTH RESOURCES AIRCRAFT PROGRAM STATUS REVIEW. VOLUME 3: HYDROLOGY, OCEANOGRAPHY, AND SENSOR STUDIES

1968 421 p refs Conf. held at Houston, Tex., 16-18 Sep. 1968

(NASA-TM-X-62566) Avail: NTIS CSCL08F

A review of the various aspects of the Earth Resources Program, divided into geology, geography, hydrology, agriculture and forestry, and oceanography, is presented. Information is presented on the current status of continuing programs, with emphasis on remote sensor applications in hydrology and oceanography.

N71-16733*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

ORBIT SELECTION CONSIDERATIONS FOR EARTH RESOURCES OBSERVATIONS

Byron L. Swenson Washington Feb. 1971 23 p refs

(NASA-TM-X-2156) Avail: NTIS CSCL 17G

The orbital mechanics problem was examined to determine if various observational requirements can be satisfied and whether a number of different types of observations can be made from a single satellite. Parametric material is presented for determining the extent to which the observational constraints must be relaxed either to perform a single observation or to make several observations compatible. It was determined that high resolution coverage of broad surface areas (i.e., areas of the order of 2000 km and greater in width) was possible within solar angle constraints but that the rapid repetition of such observations (e.g., within less than a month) was not possible with a single satellite. If rapid repetition of observations is required, either low resolution observations must be made, much smaller surface areas must be considered, or multiple satellites must be used. Author

N71-16917# Joint Publications Research Service, Washington, D.C.

SOVIET BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 244

15 Jan. 1971 90 p refs Transl. into ENGLISH from various

Sino-Soviet bloc publications
(JPRS-52185) Avail: NTIS

CONTENTS:

1. ASTRONOMY p 1-3 refs

2. METEOROLOGY p 4-18 refs

3. OCEANOGRAPHY p 19-28 refs

4. TERRESTRIAL GEOPHYSICS p 29-47 refs

5. UPPER ATMOSPHERE AND SPACE RESEARCH p 48-80 refs

6. MISCELLANEOUS: EXPEDITION DEPARTS FOR ANTARCTICA, NEWS p 81-82 ref

N71-18453# Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.

METEOROLOGICAL TRANSACTIONS, VOLUME 73, NO 1. THE INTERPRETATION OF SATELLITE PICTURES: THE PICTURE OF THE SURFACE OF THE EARTH [METEOROLOGISCHE ABHANDLUNGEN, BAND 73, HEFT 1: DIE INTERPRETATION VON SATELLITENAUFNAHMEN: DAS BILD DER ERDOBERFLAECHE]

Ingrid Haupt 1970 334 p refs In GERMAN; ENGLISH summary Original contains Color Illustrations

Avail: NTIS HC \$6.00/MF \$0.95

The basis is given for an interpretation of satellite pictures of Europe, Asia, and Africa, taken by the Tiros, Nimbus, and Essa weather satellites. In special cases and for purposes of comparison, pictures taken during Gemini space flights and those taken by the Applications Technology Satellite (ATS) are referred to. ESRO

N71-19251*# National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.

SECOND ANNUAL EARTH RESOURCES AIRCRAFT PROGRAM STATUS REVIEW. VOLUME 1: GEOLOGY AND GEOGRAPHY

1969 341 p refs Conf. held at Houston, Tex., 16-18 Sep.

1969 Original Contains Color Illustrations

(NASA-TM-X-66913) Avail: NTIS HC \$6.00/MF \$0.95 CSCL 08G

CONTENTS:

1. GEOLOGIC APPLICATIONS PROGRAM: SUMMARY OF RECENT PROGRESS AND PLANS W. R. Hemphill (Geological Survey, Wash., D.C.) 4 p refs

2. APPLICATION OF COMPUTER PROCESSES MULTISPECTRAL DATA TO THE DISCRIMINATION OF LAND COLLAPSE (SINKHOLE) PRONE AREAS IN FLORIDA A. E. Coker, R. Marshall, and N. S. Thomson (Geological Survey, Tampa, Fla.) 17 p refs

3. DIGITAL COMPUTER TERRAIN MAPPING FROM MULTISPECTRAL DATA, AND EVALUATION OF PROPOSED EARTH RESOURCES TECHNOLOGY SATELLITE (ERTS) DATA CHANNELS, YELLOWSTONE NATIONAL PARK: PRELIMINARY REPORT H. W. Smedes, K. L. Pierce, M. G. Tanguay, and R. M. Hoffer (Geological Survey, Wash. D.C.) 37 p refs

4. GEOLOGIC ANALYSIS OF THE X-BAND RADAR MOSAICS OF MASSACHUSETTS L. R. Page (Geological Survey, Wash. D.C.) 19 p refs

5. THERMAL INFRARED INVESTIGATIONS, MILL CREEK AREA, OKLAHOMA L. C. Rowan, T. W. Offield, K. Watson, and R. D. Watson (Geological Survey, Denver, Colo.) 25 p refs

6. REMOTE SENSING TECHNIQUES AS APPLIED TO COASTAL SEDIMENTATION, SOUTH TEXAS H. L. Berryhill, Jr. (Geological Survey, Corpus Christi, Tex.) 15 p

7. REMOTE DETECTION OF GEOCHEMICAL SOIL ANOMALIES F. C. Canney (Geological Survey, Denver, Colo.) 8 p

8. GEOLOGIC UTILITY OF SMALL SCALE AIRPHOTOS M. M. Clark (Geological Survey, Menlo Park, Calif.) 39 p refs

9. EFFECTIVE RADAR LOOK DIRECTIONS FOR GEOLOGIC INTERPRETATION H. C. MacDonald (Kansas Univ., Lawrence) 21 p refs

10. CARTOGRAPHY A. P. Colvocoresses (Geological Survey, Wash., D.C.) 8 p

11. SUMMARY OF OBJECTIVES AND PROGRESS IN THE GEOGRAPHIC APPLICATIONS PROGRAM A. C. Gerlach (Geological Survey, Wash., D.C.) 12 p

12. REMOTE SENSING ANALYSIS OF GRASSLAND FIRE PHENOMENA: THE FLORIDA TEST SITES, 1968-1969 M. C. Prunty (Georgia Univ., Athens) 12 p

13. THEMATIC LAND USE MAPPING: SOME POTENTIALS AND PROBLEMS D. S. Simonett (Kansas Univ., Lawrence) 43 p refs

14. IMPERIAL VALLEY LAND USE STUDIES: A CONTINUUM FROM MISSION 73 TO APOLLO 9 C. W. Johnson (California Univ., Riverside) 10 p

15. HOUSING QUALITY IN URBAN AREAS: DATA ACQUISITION AND CLASSIFICATION THROUGH THE ANALYSIS OF REMOTE SENSOR IMAGERY F. E. Horton (Iowa Univ., Iowa City), and D. F. Marble (Northwestern Univ.) 13 p

16. SURFACE ENERGY EXCHANGE PHENOMENA INTERPRETED FROM IR EXPERIMENTS R. W. Pease (California Univ., Riverside) 16 p

17. GEOGRAPHY PROGRAM REVIEW AND INTEGRATION R. H. Alexander (Geological Survey, Wash., D.C.) 23 p

**N71-19602# Geological Survey, Washington, D.C.
REMOTE SENSING BIBLIOGRAPHY FOR EARTH
RESOURCES, 1968**

Rita K. Llaverias and Dorothy G. Lowe Oct. 1970 260 p refs
/ts Interagency Rept. No. 203
(PB-195748; USGS-DO-70-010) Avail: NTIS CSCL08F

Citations of literature are presented for the following: agriculture, atmospheric sciences, cartography, fisheries, forestry, geodesy, geography, geology, geophysics, hydrology, land evaluation, limnology, marine resources, meteorology, oceanography, range resources, sensors, techniques, and urban development. A personal author index and a corporate author index are provided for most of the 801 citations. The subject index contains two or more descriptors for each item. Author (GRA)

**N71-22049# Joint Publications Research Service, Washington,
D.C.**

**SOVIET BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY,
AND SPACE, NO. 247**

1 Mar. 1971 66 p Transl. into ENGLISH from Russian reports
(JPRS-52498) Avail: NTIS

CONTENTS:

1. ASTRONOMY p 1-8
2. METEOROLOGY p 9-15

3. OCEANOGRAPHY p 16-30

4. TERRESTRIAL GEOPHYSICS p 31-40

5. UPPER ATMOSPHERE AND SPACE RESEARCH
p 41-59

**N71-22245# Geological Survey, Washington, D.C. Water
Resources Div.**

**REMOTE SENSING BIBLIOGRAPHY FOR EARTH
RESOURCES, 1966-1967**

Rita K. Llaverias May 1970 136 p refs /ts Interagency Rept.
No. 189

(PB-192863; USGS-WD-70-001) Avail: NTIS CSCL05C

The second in a series of bibliographies on remote sensing of earth resources applications is presented. The subject matter coverage is extended from the earlier more restricted area of hydrology to the broader field of earth resources, but the emphasis on water resources applications remains. Citations of literature appearing in 1966-1967 are presented from such fields as agriculture, forestry, geography, geology, hydrology, meteorology, oceanology, range management, and urban planning, to the extent that they relate to water resources. For the 412 citations, indexes are provided for personal and corporate authors; the subject term index contains three descriptors for each item. Author (GRA)

**N71-22682# Joint Publications Research Service, Washington,
D.C.**

**SOVIET BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY,
AND SPACE, NO. 248**

16 Mar. 1971 81 p refs Transl. into ENGLISH from various
Soviet bloc publications
(JPRS-52634) Avail: NTIS

CONTENTS:

1. ASTRONOMY p 1-3
2. METEOROLOGY p 4-10
3. OCEANOGRAPHY p 11-19
- 11-13)
4. TERRESTRIAL GEOPHYSICS p 20-25 refs
5. UPPER ATMOSPHERE AND SPACE RESEARCH
p 26-57 refs
6. DETAILED DESCRIPTION OF "LUNOKHOD-1" p 59-74

**N71-22801# Israel Program for Scientific Translations, Ltd.,
Jerusalem.**

PROBLEMS OF THE ARCTIC AND THE ANTARCTIC

A. F. Treshnikov, ed. 1970 531 p refs Transl. into ENGLISH
of the book 'Problemy Arktiki i Antarktiki' Leningrad,
Gidrometeorologicheskoe Izdatel'stvo, 1968-1969 531 p
Sponsored by NSF /ts Issues 29-32
(TT-70-50017) Copyright. Avail: NTIS HC\$6.00/MF\$0.95

This document covers a wide variety of Soviet scientific research related to problems peculiar to the Arctic and Antarctic regions.

A.L.

09 GENERAL

N71-23802# Geological Survey, Washington, D.C.
AEROSPACE METHODS FOR REVEALING AND EVALUATING EARTH'S RESOURCES

William A. Fishcer [1971] 16 p refs Presented at the Interreg. Seminar on Photogrammetric Tech., Zurich, Mar. 1971

Avail: Issuing Activity

The role that remote sensors should play in reaching resources and environmental decisions is described, and a synopsis of the rationale followed in the development of the EROS program is given. Remote sensor data are considered as supplementary, used basically for identification of information needs. Repetitive coverage, and an image format suitable for photographic reproduction, and information at regional scales (1:250,000 and smaller) are required. The various spaceborne sensor capabilities for information needs are discussed, and the data collection systems of ERTS-A are used as an illustration. N.E.N.

N71-26200# Committee on Commerce (U. S. Senate).
A READER IN INTERNATIONAL ENVIRONMENTAL SCIENCE

Washington GPO May 1971 164 p refs Presented to 91st Congr., 1st Sess., 18 May 1971 Prepared by Library of Congr. Environ. Policy Div. for Comm. on Com. (U. S. Senate) and Comm. on Sci. and Astronaut. (U. S. House) /Its Serial B

Avail: Comm. on Sci. and Astronaut.

International concern is expressed for the quality and productivity of the environment. Major problem areas, the status of cooperative programs, and opportunities for future research are examined. J.A.M.

N71-26263# Tennessee Univ., Knoxville.
EVALUATION OF REMOTE SENSOR IMAGES, ASHEVILLE BASIN AREA, NORTH CAROLINA

Lyman O. Williams Dec. 1970 154 p refs Prepared in cooperation with East Tennessee Univ.

(Contract F19628-69-C-0116)

(AD-719761; Scientific-1; AFCRL-71-0015) Avail: NTIS CSCL 14/5

Isopleth mapping, computation of Piersons Correlation Coefficient, and multiple linear regression analysis have been employed to analyze the system: water-vegetation-soil-rock-topography in a 50 mile long, 12 mile wide area centered on Asheville, North Carolina. Comparison of data suggests that analysis of the 100 random samples give results which are comparable to isopleth mapping of 196 sample sites for variables which have relative abundance and which have relatively contrasting properties of weathering, erodability and water retention. These variables are clay and silt in soils, quartz in soils, potassium feldspar in soils and bedrock, garnet in soils, biotite in both soils and bedrock, and muscovite in bedrock, and they appear to be dependent on a unique combination of independent variables. Accordingly it appears that lowlands (Case A) will be more likely to have clay rich soils, with relatively longer channel lengths per square mile, and to have soils which have low color values and relatively more soil moisture. The subsurface is likely to have abundant muscovite or biotite in both soils and bedrock, and garnet will be associated. Author (GRA)

N71-26398# Transportation Systems Center, Cambridge, Mass.
EARTH SURVEY BIBLIOGRAPHY: A KWIC INDEX OF REMOTE SENSING INFORMATION

William I. Thompson, III Feb. 1971 269 p refs Sponsored by NASA

(NASA-CR-118489; DOT-TSC-NASA-70-1) Avail: NTIS CSCL 08G

A collection of 1650 bibliographic citations on remote sensing of the physical characteristics of the earth is presented. The bibliography is intended to be used as a source document leading to additional information. Author

N71-26901# Joint Publications Research Service, Washington, D.C.

SOVIET BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 252

14 May 1971 45 p refs Transl. into ENGLISH from various Sino-Soviet bloc publications (JPRS-53134) Avail: NTIS

CONTENTS:

1. ASTRONOMY p 1-4 refs
2. METEOROLOGY p 5-7 refs
3. OCEANOGRAPHY p 8-10 refs
4. TERRESTRIAL GEOPHYSICS p 11-15 refs
5. UPPER ATMOSPHERE AND SPACE RESEARCH p 16-41 refs

N71-26972 World Meteorological Organization, Geneva (Switzerland). Joint Organizing Committee for GARP.
REPORT OF PLANNING CONFERENCE ON GARP

Apr. 1970 51 p Conf. held at Brussels, Mar. 1970 /Its GARP Spec. Rept. No. 1

Copyright. Avail: Issuing Activity

A planning conference on Global Atmospheric Research Program to investigate the relationships between large scale, medium scale, and small scale events in the tropical atmosphere above the Atlantic Ocean is reported. The arrangement of international cooperation and the use of satellites of different origin is discussed. The acquisition of numerical data to enter numerical atmosphere models in view of air pollution problems is mentioned.

N71-27025# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

AN EVALUATION OF EARTH RESOURCES OBSERVATION OPPORTUNITIES FROM AN ORBITING SATELLITE

E. H. Bauer and B. S. Perrine 19 May 1971 88 p refs

(NASA-TM-X-64598) Avail: NTIS CSCL 08G

The National Aeronautics and Space Administration is currently engaged in integrating, on the Skylab workshop, an Earth Resources Experiment Package (EREP) which will be exercised by each of three separate flight crews in the 1973 time frame. Other continuously manned missions which include an EREP are in the planning phase. For effective mission planning, a knowledge of the opportunities for experiment performance and of the interdependence of experiment requirements and systems constraints is mandatory. The development and application is discussed of a new mission analysis simulation technique designed to evaluate and optimize these opportunities. Factors influencing available opportunities, such as orbital parameters, solar lighting at the target, system limitations, etc., are incorporated in the simulation and analyzed to determine their effects. The USA is considered the prime target with either USA coverage time or the number of passes over the USA used as a payoff function. Optimization for various mission parameters, such as orbital inclination, launch time, and launch date, are included. The 50 deg inclined circular orbit at 435 km altitude is analyzed in depth. USA coverage time and number of passes for missions in this orbit, such as Skylab and possibly the shuttle sortie missions, are provided. Author

N71-29397# Royal Aircraft Establishment, Farnborough (England).

SPATIAL SURVEILLANCE OF NATURAL RESOURCES, PART 2

D. I. Raitt, comp. Jul. 1969 16 p refs

(RAE-LIB-BIB-314-Pt.2; RAE-LIB-BIB-308) Avail: NTIS

This selective bibliography, arranged alphabetically by author, covers the following fields: mineral deposits, agriculture (vegetation, crops, soils), forestry, wildlife, livestock, fisheries, and water resources. Author (ESRO)

N71-30294# National Science Foundation, Washington, D.C. National Science Board.

ENVIRONMENTAL SCIENCE: CHALLENGE FOR THE SEVENTIES Report of The National Science Board

1971 68 p refs

Avail: SOD \$0.40

A study is presented on all the environment surrounding man, the problems existing today and those predicted for the future, and areas for action with respect to those problems. It is pointed out that notable advances have recently been made in environmental science, and its tools and techniques. However the principal conclusion is that environmental science today is unable to match the needs of society for definitive information, predictive capability, and the analysis of environmental systems. It is recommended that the urgency of a comprehensive national program be recognized, early consideration be given to the determination of priorities, the Federal responsibility in organizing and supporting the national program be considered as important as its responsibility for environmental quality, funding for the program and facilities be ensured, and the disciplinary strength of academic institutions be increased in the field of environmental science. N.E.N.

N71-30839# Royal Swedish Academy of Engineering Sciences, Stockholm.

ARTICLES AND SPEECHES AT THE ANNIVERSARY OF IVA, 1919-1969 [AKTUELLA INLAEGG VID ETT JUBILEUM INGENJOERSVETENSKAPSAKADEMIEN, 1919-1969]

1969 247 p refs In SWEDISH

Avail: NTIS: Esselte AB, Stockholm: 18 SKR

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1. TECHNICAL EXPLOSIONS - CHANGES Sten Soederberg p 11-25
2. TECHNOLOGY AND ECONOMY - AN URGENT WELFARE PROBLEM Erik Dahmen 26-36
3. INNOVATION AND SOCIETY Bertil Jacobson p 37-43
4. TECHNOLOGY FOR HUMAN BEINGS Martin Fehrm p 44-52
5. EXPANSION OF TECHNICAL UNIVERSITIES Nils Gralen p 53-61
6. BIOCHEMISTRY AND BIOTECHNOLOGY, AN OUTLOOK TOWARDS THE YEAR 2000 G. Ehrensvaerd p 62-81
7. MEDICAL THOUGHTS FOR THE FUTURE Arne Engstroem p 82-89
8. PROBLEMS OF SCIENTIFIC RESEARCH AND COUNTRY DEVELOPMENT Carl-Goeran Heden p 90-103
9. ARCHITECTURAL DESIGN - BEFORE, NOW, AND IN FUTURE Svan Dahlberg p 104-180
10. THE OBJECTIVES AND MEANS OF SOCIETY AND COMMUNITY PLANNING Goeran Sidenbladh p 181-213 refs
11. OREGEOLOGY IN THE FUTURE A. S. Lundberg p 214-221
12. ENERGY SUPPLY - A KEY AREA IN PROCESS TRANSFORMATION F. Petri p 222-246

N71-31279*# Interplan Corp., Santa Barbara, Calif.

REVIEW AND APPRAISAL: COST-BENEFIT ANALYSES OF EARTH RESOURCES SURVEY SATELLITE SYSTEMS

Roman Krzyckowski, David N. Powell, Jr., and Evelyn S. Putnam Mar. 1971 161 p refs

(Contract NASw-2084)

(NASA-CR-119363; Rept-7016R) Avail: NTIS CSCL 22A

Ten studies concerned with the benefits and costs of remote sensing of earth resources were reviewed and appraised to assess: the extent to which the findings can be considered to be adequate indicators of the cost-benefit effectiveness of future operational ERS satellites, and the value of these studies of the ERS Program in directing R&D activities. The findings of this review and appraisal were used in formulating conclusions on the appropriate nature of future studies in the ERS Program. Author

N71-31425# North American Rockwell Corp., Downey, Calif. Space Div.

NATURAL RESOURCE MANAGEMENT INFORMATION SYSTEM AND REMOTE SENSING APPLICATIONS. INFORMATION REQUIREMENTS STUDY FOR INDIAN OPPORTUNITY PROGRAM ECONOMIC IMPROVEMENTS

18 Jun. 1970 167 p refs Prepared for Bur. of Indian Affairs Original contains color illustrations

(SD-70-351) Avail: NTIS

The results of a preliminary study designed to aid the Bureau of Indian Affairs (BIA) in the evolutionary progression of natural resources management and of reservation economic improvement are presented as an over-view of the requirements for a natural resources management information system and of the potential application of remote sensing technology to natural resource programs. It presents the study rationale, objectives and scope; the major concepts of BIA programs, emphasizing natural resources; an outline of two remote sensing programs; a systematic orientation of BIA natural resources programs and problem areas with remote sensing applications; and the delineation of a natural resources management information system methodology. Author

N71-32180*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

SWATHINGS PATTERNS OF EARTH-SENSING SATELLITES AND THEIR CONTROL BY ORBIT SELECTION AND MODIFICATION

Joseph C. King Dec. 1970 41 p refs

(NASA-TM-X-65627; X-110-70-456) Avail: NTIS CSCL 22C

A generalized investigation of the swathing patterns produced by earth observation satellites in circular, sun-synchronous orbits reveals an extensive array of orbits with interesting and varied pattern-generating properties. The study focuses on repeating type patterns, which occur well distributed over the useful range of orbital altitudes and repeat cycle periods, and in particular on minimum-drift repeating patterns. The latter are regularly distributed around a series of zero-drift altitudes and are advantageous because of their uniform swath progressions and one day intervals between adjacent swaths. A major choice or compromise in pattern selection is between extent of geographic coverage (5 to 100%) and frequency of reobservation of covered areas (1 to 20 days). However, it is possible to modify the swathing patterns of operating satellites by altering their orbits, with a propellant budget probably not exceeding a few percent of the spacecraft weight. Author

N71-32755*# Environmental Science Services Administration, Rockville, Md. BOMAP Office.

BOMEX BULLETIN, NO. 7

Jul. 1970 36 p refs Sponsored in part by NASA, AEC, DOC, DOD, NSF, DOT, and Dept. of Interior

(NASA-CR-119761) Avail: NTIS CSCL 05B

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1. ABSTRACTS OF BOMEX RELATED PAPERS, p 1-12 refs
2. HIGH LEVEL CLOUD PHOTOGRAPHY SAMPLES p 13-18

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3. RADAR DATA SAMPLE PRODUCTS p 19-24

4. STATUS OF DATA PROCESSING AND REDUCTION
(15 JUNE 1970) p 25-34

N71-31826*# National Aeronautics and Space Administration.
Goddard Space Flight Center, Greenbelt, Md.
**PROCEEDINGS OF THE GEOS-2 PROGRAM REVIEW
MEETING. VOLUME 1: GRAVIMETRIC AND GEOMETRIC
INVESTIGATIONS WITH GEOS-1 AND GEOS-2**
Nov. 1970 378 p refs Meeting held at Greenbelt, Md., 22-24
Jun. 1970 Prepared in cooperation with Computer Sci. Corp., Falls
Church, Va.
(NASA-TM-X-67271) Avail: NTIS HC \$6.00/MF \$0.95 CSCL
08N

CONTENTS:

1. GEODETIC SATELLITE DATA SERVICE REDUCED
DATA RECEIVED AND PROCESSED AS OF 15 JUNE 1970 J.
Johns p 1-6

2. THE 1969 SMITHSONIAN STANDARD EARTH AND
GLOBAL TECTONICS E. M. Gaposchkin, W. M. Kaula, and K.
Lambeck (Smithsonian Astrophysical Obs.) p 7-60 refs

3. TESTS AND COMPARISONS OF GRAVITY MODELS
USING CAMERA OBSERVATIONS OF GEOS-1 AND GEOS-2 J.
G. Marsh, B. C. Douglas (Wolf Res. and Develop. Corp., Riverdale,
Md.), and M. L. Dutcher p 61-88 refs

4. COMPARISON OF THE SAO-1969 GRAVITY FIELD
WITH SURFACE GRAVITY W. E. Strange (Computer Sci. Corp.,
Falls Church, Va.) p 89-90 refs

5. DERIVATION AND TESTS OF THE GODDARD COMBINED
GEOPOTENTIAL FIELD (GSFC L70-C) J. P. Murphy and J. G.
Marsh p 99-118 refs

6. REDUCTION OF ERRORS IN COMPUTED SATELLITE
ORBITS DUE TO UNCERTAINTIES IN GRAVITY COEFFICIENTS
R. J. Anderle (Naval Weapons Lab.) p 119-140 refs

7. COMPARISON OF GEOPOTENTIAL MODELS FOR GEOS-1
EPHEMERIS PREDICTION L. Wong and R. Prislín (Aerospace
Corp., El Segundo, Calif.) p 141-186 refs

8. NASA STADAN, SPECT, AND LASER TRACKING
STATION POSITIONS DERIVED FROM GEOS-1 AND GEOS-2
PRECISION REDUCED OPTICAL AND LASER OBSERVATIONS J.
G. Marsh, B. C. Douglas (Wolf Res. and Develop. Corp., Riverdale,
Md.), and C. F. Martin (Wolf Res. and Develop. Corp., Riverdale,
Md.) p 187-214 refs

9. NAD SURVEY ADJUSTMENTS FROM SHORT ARCS
USING GEOS-1 OBSERVATIONS F. M. Loveless, Jr. (DBA
Systems, Inc., Lanham, Md.), J. J. Lynn (DBA Systems, Inc., Lanham,
Md.), and J. H. Berbert p 215-232 refs

10. IMPROVEMENT OF THE GEOS-1 NORTH AMERICAN
TRACKING NETWORK FROM MULTIPLE SHORT ARC GEODETIC
ADJUSTMENTS G. Hadgigeorge (AFCL, Bedford, Mass.)
p 233-266 refs

11. ANALYSIS OF GEODETIC SATELLITE (GEOS-1)
OBSERVATIONS IN NORTH AMERICA I. I. Mueller, C. R. Schwarz,
and J. P. Reilly (Ohio State Univ.) p 267-296

12. EXPERIMENTS WITH WILD BC-4 PHOTOGRAPHIC
PLATES C. R. Schwarz, I. I. Mueller, J. P. Veach and D. H.
Hornbarger (Ohio State Univ.) p 297-328 refs

13. EXPERIMENTS WITH THE USE OF ORBITAL
CONSTRAINTS IN THE CASE OF SATELLITE TRAILS ON WILD
BC-4 PHOTOGRAPHIC PLATES C. R. Schwarz (Ohio State Univ.)
p 329-346 refs

14. EXPERIMENTS WITH SECOR OBSERVATIONS ON

GEOS-1 I. I. Mueller, J. P. Reilly, C. R. Schwarz and G. Blaha
(Ohio State Univ.) p 347-362 refs

15. COMPARISONS OF INDEPENDENT INVESTIGATOR'S
SURVEY ADJUSTMENTS ON THE NAD USING GEOS DATA J.
H. Berbert and F. M. Loveless, Jr. (DBA Systems, Inc., Lanham,
Md.) p 363-370 refs

16. ESTIMATES OF C BAND RADAR STATION POSITIONS
AND INTERSITE DISTANCES C. D. Leitao and R. L. Brooks (Wolf
Res. and Develop. Corp., Pocomoke, Md.) p 371-385 refs

N71-31867*# National Aeronautics and Space Administration.
Goddard Space Flight Center, Greenbelt, Md.
**PROCEEDINGS OF THE GEOS-2 PROGRAM REVIEW
MEETING. VOLUME 4: GENERAL**
Nov. 1970 282 p refs Conf. held at Greenbelt, Md., 22-24
Jun. 1970 Prepared in cooperation with Computer Sciences Corp.,
Falls Church, Va.
(NASA-TM-X-67269) Avail: NTIS CSCL 08E

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1. PERTURBATION OF GEOS-1 ORBIT BY SOLAR
RADIATION PRESSURE L. Wong and R. Prislín (Aerospace Corp.,
El Segundo, Calif.) p 1-10

2. THE ORBIT OF PAGEOS THROUGH MARCH 1970
B. Chovitz and J. Lucas (Coast and Geodetic Surv., Rockville, Md.)
p 11-30 refs

3. RADIATION PRESSURE EFFECTS ON THE
ACCELERATION OF HIGH ALTITUDE BALLOON SATELLITES
D. E. Smith and K. H. Fea (London Univ.) p 31-56 refs

4. AIR FORCE USE OF GEODETIC SATELLITE DATA
H. L. Kuykendall (Aeron. Chart and Inform. Center) p 57-68

5. NATIONAL GEODETIC SATELLITE PROGRAM (NGSP)
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Richardson (Geonautics, Inc.) p 69-96 refs

6. DATA ACQUISITION WITH THE PC-1000 CAMERA
SYSTEM N. R. Goff (Geodetic Surv. Squadron (1st), F. E. Warren
AFB, Wyo.) p 97-106

7. GEOCEIVER AS A RANGING SYSTEM D. C. Brown
(DBA Systems, Inc., Melbourne, Fla.) p 107-164 refs

8. GEOS-C PLANS R. M. Rados p 165-170

9. PLANS BY SAO FOR THE USE OF GEOS C IN GEODETIC
AND EARTH-PHYSICS INVESTIGATIONS C. A. Lundquist and
G. C. Weiffenbach (Smithsonian Astroph. Obs.) p 171-182
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10. SOME RESULTS OF A SHORT-ARC,
ORBIT-DETERMINATION STUDY RELATED TO THE GEOS-C
ALTIMETER EXPERIMENT R. M. L. Baker, Jr., D. Ourston, and
N. H. Schroeder p 183-240

11. ALTIMETER BIAS RECOVERY FROM RANGE AND ANGLE
OBSERVATIONS J. Berbert and F. Loveless (DBA Systems, Inc.,
Lanham, Md.) p 241-252 refs

12. MSFN UNIFIED S-BAND METRIC TRACKING
CAPABILITIES I. Salzberg p 253-268

13. MISTRAM APPLICATIONS WITH GEOS C N. Bush
(Pan Am. World Airways, Inc., Patrick AFB, Fla.) p 269-280

14. GEOS-C RADAR ALTIMETER J. W. Bryan p 281-292

N71-33827*# California Univ., Berkeley. Space Sciences Lab.
**AN INTEGRATED STUDY OF EARTH RESOURCES IN THE
STATE OF CALIFORNIA USING REMOTE SENSING
TECHNIQUES Progress Report**
1 Feb. 1971 196 p refs Original contains color illustrations
(Grant NGL05-003-404)
(NASA-CR-121460) Avail: NTIS CSCL 08G

An integrated approach is presented to the study of the water resources management program of California. Factors considered include: potential users; potential managers; parameters that govern the availability of water; and the extent to which remote sensing can be used to measure hydrologic parameters in the source areas. It is recommended that a similar study be made of the coastal areas.
F.O.S.

N71-34378*# Scientific Translation Service, Santa Barbara, Calif.

INFRARED PHOTOGRAPHS OF THE EARTH FROM SATELLITES AND POSSIBILITIES OF THEIR APPLICATION [INFRAROTAUFNAHMEN DER ERDE VON SATELLITEN UND IHRE AUSSAGEMOEGLICHKEIT]

Heinz Kaminski Washington NASA Sep. 1971 20 p refs Transl. into ENGLISH from J. Naturwiss. Rundschau (West Germany), v. 24, no. 6, Jun. 1971 p 244-252

(Contract NASw-2035)

(NASA-TT-F-13930) Avail: NTIS CSCL 14E

The history and applications of infrared photography are reviewed from their beginnings. Ground and satellite infrared instrumentation are explained. Practical uses of satellite infrared photographs include the following: determination of inhabited regions on the Earth, volcano research, glaciology, ocean ice determination, hydrology, energy radiation balance of the Earth.

Author

N71-35479# Geological Survey, Washington, D.C. Water Resources Div.

REMOTE SENSING BIBLIOGRAPHY FOR EARTH RESOURCES, 1969

J. P. Glasby and D. G. Lowe May 1971 194 p refs

Avail: NTIS

A bibliography on remote sensing is presented. Technical material concerning methodology and applications for earth resources studies is cited, stressing advancements in airborne and earth satellite techniques. The citations cover nine subject categories and are arranged alphabetically by title under each category and in consecutive numerical order. Each item includes title, bibliographic citation, and a set of indexing descriptors. Documents are cited for the following fields: (1) agriculture, (2) atmospheric, (3) sciences, (4) cartography, (5) ecology, (6) fisheries, (7) forestry, (8) geodesy, (9) geography, (10) geology, (11) geomorphology, (12) geophysics, (13) glaciology, (14) hydrology, (15) instrumentation, (16) land use, (17) limnology, (18) marine resources, (19) techniques, (20) urbanization, and (21) water resources. Indexes with applicable citation numbers are provided for author, corporate author, and subject terms. The cumulative subject term index at the end of the volume provides the necessary access to the key-word descriptors.

Author

N71-37422*# National Aeronautics and Space Administration, Washington, D.C.

SPACE MARATHON

V. Kitain, comp. Sep. 1971 181 p Transl. into ENGLISH of the book "Kosmicheskii Marafon" Moscow, Izvestiya Press, 1970 p 1-239

(NASA-TT-F-13788) Avail: NTIS CSCL 22C

A day-by-day account is presented of the flight of the Soyuz 9 spacecraft. Particular emphasis is placed on the extensive program of scientific research and biomedical experiments conducted by the cosmonauts during the 18 days of orbital flight. In addition to the reports given by the cosmonauts during communication with ground stations, commentaries by Soviet scientists concerning the significance of the research are also presented.

D.L.G.

N71-37928*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

SOME CONSIDERATIONS IN THE SELECTION OF AIRCRAFT FOR EARTH RESOURCE OBSERVATIONS

Roger D. Arno and Jerry M. Deerwester Washington Oct. 1971 18 p refs

(NASA-TM-X-2418; A-4046) Avail: NTIS CSCL 08G

The logistics problems and cost aspects of earth resource surveys using various types of aircraft are discussed. Eight categories of aircraft (from piston engine to large jet) as well as commercial air carriers are examined on the basis of quantity needed, coverage afforded, and annual program cost. Independent parameters in the analysis include (1) the requirements of a typical group of resource features, (2) number and location of bases, (3) cloud cover uncertainty, and (4) aircraft cost and the parametric influence of payload associated costs. The results obtained in this analysis show an advantage in cost and rate of coverage for a special fleet of twin-engine turbojets over all other aircraft options. Special fleets of turboprop, large turbojet, piston engine planes and commercial air carriers were found to be inferior, principally, because of the greater number of aircraft required to achieve comparable coverage. To illustrate, to cover 45 to 95 percent of the resources considered about every two weeks, the special fleet of twin-engine jets requires 6 to 30 aircraft, while the commercial air carrier numbers range from 36 to 180 for coverage ranging from 40 to 80 percent. Annual program operating costs would appear to run between \$2 and \$10 million plus the costs associated with payload and data handling. Total costs might average between \$10 and \$100 million annually.

Author

N71-38189*# Allied Research Associates, Inc., Concord, Mass. **DEVELOPMENT OF FOUR-DIMENSIONAL ATMOSPHERIC MODELS (WORLDWIDE) Final Report**

David B. Spiegler and James R. Greaves Aug. 1971 97 p refs (Contract NAS8-25618)

(NASA-CR-61362) Avail: NTIS CSCL 04B

Mean monthly values and daily variances of moisture, temperature, density, and pressure were generated at 1 km intervals from the surface to 25 km using global atmospheric data extracted from various sources. The resultant profiles were stratified into homogeneous moisture regions covering both hemispheres. Analytic functions were developed to fit the mean and daily variance profiles within each region. Given the latitude, longitude and month, the mean and daily variance profiles of all four atmospheric parameters can be generated. These profiles can then serve as input to attenuation models that predict the degree of atmospheric attenuation likely to be encountered by satellite or air-borne electromagnetic sensors engaged in earth resources observations. Detailed moisture profiles for two radiosonde locations along the mid-Atlantic Coast and the Gulf Coast were analyzed and 12- and 24-hour conditional tables of moisture amount were generated at kilometer levels. The feasibility of developing frequency distributions of moisture content profiles was investigated using the data from the two radiosonde stations.

Author

N72-10274* National Aeronautics and Space Administration, Washington, D.C.

NASA TO SURVEY EARTH'S RESOURCES

Richard T. Mittauer 20 Oct. 1971 29 p

(NASA-News-Release-71-202) Avail: NTIS CSCL 22B

A wide variety of the natural resources of earth and man's management of them will be studied by an initial group of foreign and domestic scientists tentatively chosen by the National Aeronautics and Space Administration to analyze data to be gathered by two earth-orbiting spacecraft. The spacecraft are the first Earth Resources Technology Satellite (ERTS-A) and the manned Skylab which will carry an Earth Resources Experiment Package (EREP). In the United States, the initial experiments will study the feasibility of remote sensing from a satellite in gathering information on ecological problems. The objective of both ERTS and EREP aboard Skylab is to obtain multispectral images of the surface of the earth with high resolution remote sensors and to process and distribute the images to scientific users in a wide variety of disciplines. The ERTS-A, EREP, and Skylab systems are described and their operation is discussed.

Author

N72-10856*# National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.

THE GEMINI PROGRAM: PHYSICAL SCIENCES EXPERIMENTS SUMMARY

09 GENERAL

Edward O. Zeitler, comp. and Thomas G. Roger comp. (ITT Federal Electric Corp. Houston, Tex.) Sep. 1971 554 p refs (NASA-TM-X-58075) Avail: NTIS HC \$8.00/MF \$0.95 CSDL 22C

Results and findings of physical sciences experiments performed in the Gemini program are presented. The summary contains descriptions of selected studies in the fields of astronomy, navigation, radiation, geophysics, meteorology, photography, and communications.

N72-12248*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
THIRD ANNUAL EARTH RESOURCES PROGRAM REVIEW. VOLUME 1: GEOLOGY AND GEOGRAPHY
1970 275 p refs Conf. held at Houston, Tex., 1-3 Dec. 1970 Original contains color illustrations (NASA-TM-X-67403; MSC-03742-Vol-1) Avail: NTIS CSDL 08F

Various aspects of geology and geography in the earth resources program are reviewed. Emphasis was placed on the data received from the Manned Spacecraft Center.

N72-12249*# Geological Survey, Washington, D.C.
INTRODUCTORY COMMENTS ON THE USGS GEOGRAPHIC APPLICATIONS PROGRAM
Arch C. Gerlach /in NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 5 p

Avail: NTIS CSDL 08F

The third phase of remote sensing technologies and potentials applied to the operations of the U.S. Geological Survey is introduced. Remote sensing data with multidisciplinary spatial data from traditional sources is combined with geographic theory and techniques of environmental modeling. These combined inputs are subject to four sequential activities that involve: (1) thematic mapping of land use and environmental factors; (2) the dynamics of change detection; (3) environmental surveillance to identify sudden changes and general trends; and (4) preparation of statistical model and analytical reports. Geography program functions, products, clients, and goals are presented in graphical form, along with aircraft photo missions, geography test sites, and FY-70. J.A.M.

N72-12257*# Geological Survey, Washington, D.C.
GEOGRAPHY PROGRAM, DESIGN, STRUCTURE AND OPERATIONAL STRATEGY
Robert H. Alexander /in NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 9 p

Avail: NTIS CSDL 08F

The geography program is designed to move systematically toward a capability to increase remote sensing data into operational systems for monitoring land use and related environmental change. The problems of environmental imbalance arising from rapid urbanization and other dramatic changes in land use are considered. These overall problems translate into working level problems of establishing the validity of various sensor-data combinations that will best obtain the regional land use and environmental information. The goal, to better understand, predict, and assist policy makers to regulate urban and regional land use changes resulting from population growth and technological advancement, is put forth. Author

N72-12268*# Bureau of Indian Affairs, Washington, D.C.
A REVIEW OF APPLICATION STUDIES ON INDIAN LANDS USING NASA AEROSPACE IMAGERY
Arthur M. Woll /in NASA. Manned Spacecraft Center 3d Ann. Earth Resources Program Rev., vol. 1 1970 6 p

Avail: NTIS CSDL 08G

Three remote sensing projects are being conducted on three different Indian reservations in eastern Arizona. On the Fort Apache Reservation, a multiband thermal and false color sensing of an Englemann spruce beetle infestation is being investigated

on Mount Baldy, adjacent to a U.S. Forest Service proposed wilderness area. On the San Carlos Reservation, there is a joint USGS, EROS, and San Carlos tribe project to examine intensively a circular topographic feature noted on the Apollo 9 imagery. On the Papago Reservation, an EROS-funded contract will provide the Papago tribe with a report showing potential mineral areas, by comparing and correlating space imagery with high resolution imagery and aeromagnetic data. Author

N72-12269*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
THIRD ANNUAL EARTH RESOURCES PROGRAM REVIEW. VOLUME 2: AGRICULTURE, FORESTRY, AND SENSOR STUDIES

1970 640 p refs Conf. held at Houston, Tex., 1-3 Dec. 1970 Original contains color illustrations (NASA-TM-X-67404; MSC-03742-Vol-2) Avail: NTIS HC \$9.00/MF \$0.95 CSDL 02B

A review of various aspects of the Earth Resources Program is provided that places special emphasis on results of analysis of data obtained by aircraft or spacecraft. Remote sensors and data reduction techniques as applied to agriculture and forestry are outlined.

N72-13302*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
EARTH RESOURCES RESEARCH DATA FACILITY R AND D FILE. VOLUME 1: DOCUMENTARY DATA
Jul. 1971 505 p ref (NASA-TM-X-67421; MSC-02577-Vol-1) Avail: NTIS CSDL 08G

Cumulative listings of the R and D file data are presented. All Earth Resources Program information available at the Manned Spacecraft Center is in Vol. 1. Sensor data collected during flights over NASA test sites and from missions flown by subcontractors supporting the Earth Resources Survey Program are included in Vol. 2. Author

N72-13303*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
EARTH RESOURCES RESEARCH DATA FACILITY R AND D FILE. VOLUME 2: SENSOR DATA
Jul. 1971 339 p ref (NASA-TM-X-67420; MSC-02577-Vol-2) Avail: NTIS CSDL 08G

Cumulative listings of the R and D file data are presented. All Earth Resources Program information available at the Manned Spacecraft Center is in Vol. 1. Sensor data collected during flights over NASA test sites and from missions flown by subcontractors supporting the Earth Resources Survey Program are included in Vol. 2. Author

N72-13851*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
EREP USERS HANDBOOK
Mar. 1971 379 p refs Revised (NASA-TM-X-67462; NASA-S-71-13209-F-Rev) Avail: NTIS HC \$6.00/MF \$0.95 CSDL 22B

Revised Skylab spacecraft, experiments, and mission planning information is presented for the Earth Resources Experiment Package (EREP) users. The major hardware elements and the medical, scientific, engineering, technology and earth resources experiments are described. Ground truth measurements and EREP data handling procedures are discussed. The mission profile, flight planning, crew activities, and aircraft support are also outlined. N.E.N.

N72-13866*# National Aeronautics and Space Administration, Washington, D.C.
SATELLITES AT WORK (SPACE IN THE SEVENTIES)
William R. Corliss Jun. 1971 29 p Original contains color illustrations (NASA-EP-84) Avail: NTIS; SOD \$0.60 as 3300-0405 CSDL 22B

The use of satellites in the areas of communications, meteorology, geodesy, navigation, air traffic control, and earth resources technology is discussed. NASA contributions to various programs are reviewed. K.P.D.

N72-14339 Department of Energy, Mines and Resources, Ottawa (Ontario).

RESOURCE SATELLITES AND REMOTE AIRBORNE SENSING FOR CANADA REPORT NO. 9: SATELLITE AND GROUND STATION ENGINEERING

1971 43 p

(M75-2/9) Copyright. Avail: NTIS

A number of potential Canadian sites for an Earth Resources Technology Satellite (ERTS) ground station are evaluated, and the costs of developing a ground station at the different locations are estimated. Although a station at Churchill would provide the best coverage of Canadian terrain, it is recommended that the station be located at Prince Albert, Saskatchewan; largely because of the short time available for the design and construction. The gain of the 84-foot dish antenna at Prince Albert has been measured, and found adequate for the ERTS mission so that only the feed and tracking system need be replaced. The amount of data that can be acquired by the station is estimated to vary between 25 and 40 minutes per day depending on the season. Author

N72-14824* National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.

SKYLAB 4 PRELIMINARY REFERENCE EARTH RESOURCES EXPERIMENT PACKAGE (EREP) PASS PLANNING DOCUMENT. VOLUME 1: GROUNDTRACKS

Alfred N. Lunde 3 Jun. 1971 189 p refs

(NASA-TM-X-67451; MSC-IN-71-FM-210-Vol-1;

MSC-04389-Vol-1) Avail: NTIS CSCL 22C

Ground tracks and some ground track-associated parameters of the Skylab 4 (SL-4) mission are presented for a rapid evaluation and determination of EREP passes. The data are based on an SL-1 launch at 17h 30m 0.00s Greenwich mean time on 30 April 1973. Author

N72-14825* National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.

SKYLAB 3 PRELIMINARY REFERENCE EARTH RESOURCES EXPERIMENT PACKAGE (EREP) PASS PLANNING DOCUMENT. VOLUME 2: EREP SITES AND S190 SWATH STUDY OF SELECTED REVS

Alfred N. Lunde 8 Jun. 1971 164 p refs

(NASA-TM-X-67453; MSC-71-FM-219; MSC-04354-Vol-2)

Avail: NTIS CSCL 22C

The ground tracks and S190 swaths are presented of selected revolutions over areas containing earth resources experiment package (EREP) sites. The following eight EREP disciplines are shown: sensor performance evaluation, forestry, geology, hydrology, land use mapping, oceanography, pollution, and weather. Most of the data reported consists of passes over the continental United States. F.O.S.

N72-14826* National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.

SKYLAB 4 PRELIMINARY REFERENCE EARTH RESOURCES EXPERIMENT PACKAGE (EREP) PASS PLANNING DOCUMENT. VOLUME 2: EREP SITES AND S190 SWATH STUDY OF SELECTED REVS

Alfred N. Lunde 3 Jun. 1971 152 p refs

(NASA-TM-X-67452; MSC-IN-71-FM-216-Vol-2;

MSC-04389-Vol-2) Avail: NTIS CSCL 22C

Ground tracks with S190 swaths of selected revolutions as they pass over areas containing EREP sites are presented. Most of the data consists of passes over the continental United States; several are shown over Australia and South America. The S190 is a 6-channel high precision 70 mm camera facility. Author

N72-16284 European Space Research Organization, Paris (France).

DIRECTORY OF EUROPEAN ACTIVITIES IN THE REMOTE SENSING OF EARTH RESOURCES

Nov. 1971 80 p

Avail: Issuing Activity

A directory of European activities in the remote sensing of earth resources was compiled to provide information on the European organizations and institutions actively involved in the remote sensing of earth resources. A common format was used to present information on the different institutions, the principal investigators, the experimental programs, the sensors, and remote platforms. Cooperative programs existing between European institutions and NASA are discussed, in particular for the earth resources technology satellite and Skylab earth resources experiment package programs. Author (ESRO)

N72-18310 European Space Research Organization, Paris (France).

ESRO CONSULTANTS REPORT ON THE REQUIREMENTS AND RECOMMENDATIONS FOR A EUROPEAN PROGRAMME IN THE REMOTE SENSING OF EARTH RESOURCES

Oct. 1971 89 p refs Partly in FRENCH and partly in ENGLISH

Avail: Issuing Activity

Geoscientists from ESRO attended the International Workshop on Earth Resources Survey Systems and the Seventh International Symposium on Remote Sensing of the Environment. The consultants' reports from European countries are presented and include: description of their national program in the remote sensing of earth resources; the reasons and needs for a European program; and recommendations on the role ESRO should adopt in a European program.

N72-18311 European Atomic Energy Community, Ispra (Italy). **NECESSITY AND IMPORTANCE OF A EUROPEAN PROGRAM FOR REMOTE SENSING [LA NECESSITE ET L'IMPORTANCE D'UN PROGRAMME EUROPEEN DE TELEDETECTION]**

L. VanWambeke In ESRO Consultants Report on the Requirements and Recommendations for a European Programme in the Remote Sensing of Earth Resources Oct. 1971 p 1-17 refs In FRENCH

(CCR/29/71-F) Avail: Issuing Activity

The need for coordination of European programs for remote sensing of earth resources is emphasized. An experimental aircraft and a European satellite for surveying the earth resources of developing countries are considered. A role for ESRO in the European earth resources remote sensing program is suggested. ESRO

N72-18312 Ludwig-Maximilians-Universitat, Munich (West Germany). Dept. of Photogeology and Remote Sensing.

NECESSITY AND IMPORTANCE OF AN EARTH RESOURCES SATELLITE PROGRAM IN EUROPE

J. Bodechtel In ESRO Consultants Report on the Requirements and Recommendations for a European Programme in the Remote Sensing of Earth Resources Oct. 1971 p 18-35 refs

Avail: Issuing Activity

Emphasis is placed on the increasing necessity of using satellites rather than aircraft in earth resources remote sensing. Some potential applications of earth resources satellites are mentioned. A proposal is made for a European program applying photointerpretation. The role of ESRO in the European earth resources remote sensing program is considered. Earth resources activities and available equipment in Germany are mentioned. ESRO

N72-18314 Milan Univ. (Italy). Dept. of Terrestrial Physics. **REMOTE SENSING TECHNIQUES AND THEIR IMPORT-**

09 GENERAL

ANCE IN THE EARTH RESOURCES PROGRAMME AND THE STUDY OF THE ENVIRONMENT

R. Cassinla /In ESRO Consultants Report on the Requirements and Recommendations for a European Programme in the Remote Sensing of Earth Resources Oct. 1971 p 48-57

Avail: Issuing Activity

Remote sensing principles and equipment are reviewed. The Italian program on earth resources remote sensing is briefly outlined. The need for a European program including an earth resources survey aircraft as a preliminary step to either a European earth resources technology satellite or to European participation in NASA-manned or unmanned space flights is reported. Possible fields of application are considered. ESRO

N72-18315 Netherlands Interdepartmental Working Group on the Application of Remote Sensing. Delft.

REMOTE SENSING APPLICATION RESEARCH PROGRAMME IN THE NETHERLANDS

Eric R. Bosman and David Eckhart /In ESRO Consultants Report on the Requirements and Recommendations for a European Programme in the Remote Sensing of Earth Resources Oct. 1971 p 58-64

Avail: Issuing Activity

The history of the national earth resources remote sensing program in the Netherlands is outlined. The NIWARS (Netherlands Interdepartmental Working-Committee for the Applications of Remote Sensing) program, structure, and organization are reviewed. ESRO

N72-18316 Teleplan A.B., Solna (Sweden).

SOME COMMENTS ON A POSSIBLE ESRO EARTH RESOURCES PROGRAM

Gunnar Hoppe and Stefan Zenker /In ESRO Consultants Report on the Requirements and Recommendations for a European Programme in the Remote Sensing of Earth Resources Oct. 1971 p 65-68 ref

Avail: Issuing Activity

Remote sensing activities in Sweden are outlined. Suggestions are made for establishing a European earth resources remote sensing program. ESRO

N72-18317 Zurich Univ. (Switzerland). Dept. of Geography. [FUTURE RESEARCH IN REMOTE SENSING IN SWITZERLAND]

Harold Haefner /In ESRO Consultants Report on the Requirements and Recommendations for a European Programme in the Remote Sensing of Earth Resources Oct. 1971 p 69-76

Avail: Issuing Activity

American and Swiss earth resources programs are described and compared. A proposal is made for a European earth resources remote sensing program including an experimental aircraft. The ultimate goal of a European earth resources satellite is considered. ESRO

N72-18318 Royal Aircraft Establishment, Farnborough (England). Space Dept.

EARTH RESOURCES SENSING TECHNOLOGY IN EUROPE

S. L. Entres /In ESRO Consultants Report on the Requirements and Recommendations for a European Programme in the Remote Sensing of Earth Resources Oct. 1971 p 77-85

Avail: Issuing Activity

American and European earth resources programs and remote sensing techniques are considered. European needs and the role of ESRO as coordinator in a European program are emphasized. The ways and means by which ESRO could be organized and equipped are discussed in order to: give technological assistance to national investigations; carry out an approved research and development program; and harmonize among European investigators, as well as with the US, data

acquisition and analysis techniques for improved efficiency of the investigators. ESRO

N72-18331*# California Univ., Berkeley. Forestry Remote Sensing Lab.

MONITORING EARTH RESOURCES FROM AIRCRAFT AND SPACECRAFT

Robert N. Colwell et al Washington NASA 1971 203 p refs Sponsored by NASA Original contains color illustrations (NASA-SP-275; LC-73-170325) Avail: NTIS; SOD \$4.00 CSCL 08G

An experiment that sought to determine the extent to which earth resources might be monitored by means of periodic inventories made with the aid of aerial and Apollo 9 photography is described. Several geographic locations were investigated with special emphasis on farm crops and vegetation. The value of such results to resource management is also examined.

N72-18332*# California Univ., Berkeley.

MONITORING EARTH RESOURCES FROM AIRCRAFT AND SPACECRAFT: INTRODUCTION

R. N. Colwell /In its Monitoring Earth Resources from Aircraft and Spacecraft 1971 p 1-7 refs

Avail: NTIS; SOD \$4.00 CSCL 08G

Data from the Apollo 9 photographs, taken by the Hasselblad camera, infrared Ektachrome color black and white film, are discussed. The black and white three camera system photographs are compared to those of the infrared color system. In addition to producing the sharpest photographs, the black and white system can take photographs on three different wavelengths simultaneously, has uniform color balance, and its sequential photographs can be color combined and enhanced. The infrared system has no color uniformity, shows sharp vegetation features but other earth features are unclear, and the film is difficult to process in the distinct features needed to assign color codes to various earth resources. The sequential photographs of earth resources taken by high altitude aircraft are also discussed.

E.H.W.

N72-18341*# California Univ., Berkeley.

SIGNIFICANCE OF THE RESULTS OBTAINED IN RELATION TO USER REQUIREMENTS

Robert N. Colwell /In its Monitoring Earth Resources from Aircraft and Spacecraft 1971 p 151-165 refs

Avail: NTIS; SOD \$4.00 CSCL 08G

The significance of results obtained on earth resources using sequential aerial and Apollo 9 photography is examined. Conclusions show: (1) user requirements for such information is great, (2) other types of inventory data are needed beyond those investigated, and (3) acquisition of additional information that is required in earth resources survey can be facilitated through proper use of these types of photography. E.H.W.

N72-18342*# California Univ., Berkeley.

MONITORING EARTH RESOURCES FROM AIRCRAFT AND SPACECRAFT: SUMMARY AND CONCLUSIONS

Robert N. Colwell /In its Monitoring Earth Resources from Aircraft and Spacecraft 1971 p 167-170

Avail: NTIS; SOD \$4.00 CSCL 08G

A summary of the experimental results obtained both quantitatively and qualitatively during earth resources monitoring is presented. Also given are the conclusions as to advantages, limitations, and overall feasibility of monitoring earth resources with the aid of aerial and space photography. E.H.W.

N72-18351*# Geological Survey, Washington, D.C.

GEOGRAPHIC APPLICATIONS PROGRAM: REPORTS COMPLETED AND IN PREPARATION

Robert H. Alexander, comp. Aug. 1969 16 p refs (NASA Order W-12570)

(NASA-CR-125644; USGS-IR-NASA-154) Avail: NTIS CSCL 08F

The purpose of the present compilation is to bring together for ready reference a list of all reports, both completed and in preparation, resulting from NASA sponsorship of the geography

program. Wherever possible, complete bibliographic citations are given. Since some of the 141 reports listed are not yet completed, citations can not all be in complete form. The reason for including incomplete citations is the sponsor's need for rather rapid feed-back of information so that it can have a bearing on on-going program planning. This should, therefore, be considered a working bibliography. Author

N72-19430*# Research Analysis Corp., McLean, Va. Science and Technology Dept.

PROGRAM MANAGEMENT MODEL STUDY

J. J. Connelly, J. E. Russell, J. R. Seline, and N. R. Sumner Feb. 1972 183 p refs

(Contract NAS5-11398)

(NASA-CR-122363; RAC-CR-50) Avail: NTIS CSCL 08G

Two models, a system performance model and a program assessment model, have been developed to assist NASA management in the evaluation of development alternatives for the Earth Observations Program. Two computer models were developed and demonstrated on the Goddard Space Flight Center Computer Facility. Procedures have been outlined to guide the user of the models through specific evaluation processes, and the preparation of inputs describing earth observation needs and earth observation technology. These models are intended to assist NASA in increasing the effectiveness of the overall Earth Observation Program by providing a broader view of system and program development alternatives. Author

N72-19455# Engineer Agency for Resources Inventories, Washington, D.C.

**NATIONAL RESOURCES SURVEY GUIDANCE MANUAL
RESOURCES ATLAS PROJECT: THAILAND**

Ernest Jackman Nov. 1971 242 p refs

(DACA71-69-C-0014; ARPA Order 1035)

(AD-734007) Avail: NTIS CSCL 08/6

The basic purpose of this guidance manual is to make available the practical and technical experience accumulated during many years of work in the preparation of resources inventory studies. Included in this manual are an introductory chapter; a chapter on planning of resources inventory studies; a chapter on maps, aerial photography and cartographic techniques; a chapter on text preparation; and a chapter on data storage and retrieval. Appendixes include organizational charts of the Applied Scientific Research Corporation of Thailand and Resources Inventory Group, job descriptions for RIG, descriptions and details for 32 inventory topics, map coverage indexes for Thailand, and an example of a flow chart. Author (GRA)

N72-19989# Arctic Inst. of North America, Washington, D.C.
ARCTIC LOGISTICS SUPPORT TECHNOLOGY Summary Report

H. Bader, D. Tyree, and H. Love Dec. 1971 55 p Symp. held in Hershey, Pa., 1-4 Nov. 1971

(Contract N00014-70-A-0219-0003)

(AD-734646; AINA-TR-1) Avail: NTIS CSCL 15/5

The document is a summary report of a symposium held to identify, examine, and propose better ways of providing support to ARPA's research efforts in the Arctic Basin. ARPA's interests in the Arctic were identified to focus on mobility, undersea operations and information gathering. Important technologies were said to include such things as surface effect vehicles, under-ice acoustics, remote sensing, and cold region construction. It was emphasized that the ARPA arctic research program is an integral part of the total national arctic program. Papers were presented that described both the current state of the art for arctic logistics support technology and projected future development. They were divided into three main subject areas: (1) transportation, (2) life support, and (3) activity support, i.e., meeting special needs of field investigators in performance of their activities. Author (GRA)

N72-20342*# Allied Research Associates, Inc., Concord, Mass.
NIMBUS EARTH RESOURCES OBSERVATIONS

Romeo R. Sabatini, George A. Rabchevsky, and John E. Sissala Nov. 1971 271 p refs

(Contract NAS5-21617)

(NASA-CR-122348; TR-2; Rept-9G90-8) Avail: NTIS CSCL 08G

The potential for utilizing data gathered by Nimbus satellites to study the earth surface and its physical properties is illustrated. The Nimbus data applicable to investigations of the earth and its resources, and to the problems of resolution and cloud cover are described. Geological, hydrological, and oceanographic applications are discussed. Applications of the data to other fields, such as cartography, agriculture, forestry, and urban analysis are presented. Relevant information is also given on the Nimbus orbit and experiments; surface and atmospheric effects on HRIR and THIR radiation measurements; and noise problems in the AVCS, IDCS, HRIR, and THIR data. Author

N72-20343*# California Univ., Los Angeles. Space Sciences Lab.

**AN INTEGRATED STUDY OF EARTH RESOURCES IN THE
STATE OF CALIFORNIA USING REMOTE SENSING
TECHNIQUES Semiannual Progress Report**

Robert N. Colwell 1 Jan. 1972 446 p refs Original contains color illustrations

(Grant NGL-05-003-404)

(NASA-CR-125828) Avail: NTIS HC \$6.00/MF \$0.95 CSCL 08G

Plans are presented for an integrated study of the entire California resource complex through remote sensing from aircraft and spacecraft and the socio-economic factors affecting present and future resource management.

N72-20344*# California Univ., Los Angeles.

INTRODUCTION

In its An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Tech. 1 Jan. 1972 11 p

Avail: NTIS HC \$6.00/MF \$0.95 CSCL 08G

The background behind the inception of this proposal is briefly described. The reasons for selecting California for the test site were: (1) wide variety of earth resources, landforms, and climatic factors; (2) large amounts of remote sensing data and associated ground truth data already available; (3) social and environmental stresses already being felt make California a model of things to come, both nationally and globally; (4) many competent investigators known to be residing in the state; and (5) appropriate NASA-funded facilities already in California available to provide administrative and monitoring support. The nature and delicacy of conducting such a study are reviewed, along with the types of data integration to be achieved. A.L.

N72-20345*# California Univ., Los Angeles. Social Sciences Group.

**DEFINITION OF EARTH RESOURCE POLICY AND
MANAGEMENT PROBLEMS IN CALIFORNIA**

C. West Churchman, William Gotcher, Ida Hoos, Ralph Lewis, and Richard O. Mason *In its* An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Tech. 1 Jan. 1972 106 p refs

Avail: NTIS HC \$6.00/MF \$0.95 CSCL 08G

The socioeconomic aspects of the Earth Resources Program are investigated in detail and the need to understand the beneficiaries of the ERTS technology, their relationship to the information, and the decisions which could be influenced by this information are emphasized. Three main lines of endeavor are discussed: (1) clearer definition of questions needing clarification and definition before meaningful answers can be sought; (2) development of a taxonomy of beneficiaries of data; and (3) preliminary modeling of the Feather River Project. A.L.

N72-20347*# California Univ., Berkeley. Forestry Remote Sensing Lab.

REMOTE SENSING DATA AS AN AID TO RESOURCE

MANAGEMENT IN NORTHERN CALIFORNIA

Gene A. Thorley, David Carnegie, William Draerer, Donald Lauer, Jerry Lent, and Edwin Roberts *In its An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Tech.* 1 Jan. 1972 144 p refs Original contains color illustrations

Avail: NTIS HC \$6.00/MF \$0.95 CSCL 08G

An evaluation is being made of the usefulness of remote sensing data in providing general land use planning information pertaining to the coastal zone of northern California. The test area covers the entire coast of California extending from the San Francisco Bay Area to the Oregon border. Attempts will be made to enumerate those physical parameters of the landscape which are of particular importance in determining the potential of an area in terms of land use, be it natural resource utilization, urban development, or industrial development. A quantitative evaluation will be made of the degree to which these parameters can be mapped or otherwise extracted from remote sensing data by means of both human interpretation and automatic feature classification. A.L.

N72-20958# Committee on Science and Astronautics (U. S. House).

PANEL ON SCIENCE AND TECHNOLOGY THIRTEENTH MEETING: REMOTE SENSING OF EARTH RESOURCES

Washington GPO 1970 412 p refs Proc. before the Comm. on Sci. and Astronaut., 92d Congr., 2d Sess., no. 13, 25-27 Jan. 1972

Avail: Comm. on Sci. and Astronaut.

Testimony given before the Committee on Science and Astronautics on the current state of the technology applicable to the research and development phase of remote sensing systems for earth resources is presented. Presentations covered: projections of additional requirements needed as these systems approach operational; identification of potential users of various data to be produced by the systems; organizational framework needed to establish effective operational systems; international implications of remote sensing systems; and problems of data handling and dissemination. A.L.

N72-22376# Joint Publications Research Service, Arlington, Va. **SPACE METHODS FOR TERRESTRIAL STUDIES**

B. V. Vinogradov and K. Ya. Kondratyev 18 Apr. 1972 238 p refs Transl. into ENGLISH of the book "Kosmich. Metody Zamlevedeniya" Leningrad, Gidrometeorol. Izd., 1971 792 p (JPRS-55746) Avail: NTIS

Space methods of terrestrial studies are discussed in application to physics of the atmosphere, oceanography, hydrography, continental waters, soil and vegetation, geologic structure, and topography. An analysis is presented of television images and original photographs of the earth obtained from various space vehicles. An interpretation is given of local images which provide regional and global information on the natural environment. Author

N72-22878*+ National Aeronautics and Space Administration, Washington, D.C.

REFERENCE EARTH ORBITAL RESEARCH AND APPLICATIONS INVESTIGATIONS (BLUE BOOK). VOLUME 4: EARTH OBSERVATIONS

15 Jan. 1971 82 p refs (NHB-7150.1-Vol-4) Avail: NTIS; SOD \$0.75 CSCL 08G

The earth observations capability of the space station and space shuttle program definition is discussed. The stress in the functional program element has been to update the sensor specifications and to shift some of the emphasis from sensors to experiments to be done aboard the facility. The earth observations facility will include provisions for data acquisition, sensor control and display, data analysis, and maintenance and repair. The facility is research and development in nature with a potential for operational applications. Author

N72-23280 Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.

PROCEEDINGS OF THE PRINCETON UNIVERSITY**CONFERENCE ON AEROSPACE METHODS FOR REVEALING AND EVALUATING EARTH'S RESOURCES**

J. Preston Layton, ed. Jun. 1970 322 p refs Conf. held at: Princeton, N. J., 25-26 Sep. 1969

Copyright. Avail: Issuing Activity

Conference papers are presented on the use of aircraft and spacecraft for sensing earth resources. The general topics covered are advanced remote sensor technology, aircraft and spacecraft systems, data management, data requirements from the user's standpoint, and economic and international aspects.

N72-23285 General Electric Co., Philadelphia, Pa. Missile and Space Div.

TECHNOLOGICAL POSSIBILITIES OF THE EARTH RESOURCES PROGRAM

Daniel J. Fink *In* Princeton Univ. Proc. of the Princeton Univ. Conf. on Aerospace Methods for Revealing and Evaluating Earth's Resources Jun. 1970 7 p

Copyright. Avail: Issuing Activity

Potential applications of satellites to the field of earth resources are discussed, and instrumentation is described. The problem is considered to be complex due to the broad range of disciplines involved and to the wide variety of ideas and interests of the participants. Remote sensors such as multispectral scanners, microwave sensors, correlation spectrometers and those for measuring polarized reflectance and very weak electromagnetic and gravitational fields are mentioned. The massive problem of data handling and the application of bionics to remote sensing are also considered. N.E.N.

N72-23290 Committee on Science and Astronautics (U. S. House).

AN EARTH RESOURCES SATELLITE SYSTEM IN A POLITICAL LIGHT

c31 Joseph E. Karth *In* Princeton Univ. Proc. of the Princeton Univ. Conf. on Aerospace Methods for Revealing and Evaluating Earth's Resources Jun. 1970 10 p refs

Copyright. Avail: Issuing Activity

Political aspects of the United States space program in general and of the ERTS program in particular are discussed. It is pointed out that the space accomplishments of the first ten years were political as well as scientific and technological. Today's climate is described as one of restraint and skepticism, partly because the United States has overcome the early Soviet lead and partly because the anxiety of possible military implications have dissipated. It is felt that a better balance between manned and unmanned programs must be achieved, with emphasis on improving the quality of life. The political background of ERTS is reviewed, and the reluctance of NASA to undertake the unmanned program and the Bureau of the Budget's demand for a cost-benefit analysis are mentioned. International implications are also considered. N.E.N.

N72-23296*# National Aeronautics and Space Administration, Washington, D.C.

STATUS AND PROSPECTS OF INTERNATIONAL EARTH RESOURCES SATELLITE PROGRAMS

Arnold W. Frutkin *In* Princeton Univ. Proc. of the Princeton Univ. Conf. on Aerospace Methods for Revealing and Evaluating Earth's Resources Jun. 1970 9 p

(NASA-TM-X-67713) Avail: NTIS HC \$3.00 CSCL 08G

The experimental and international aspects of the ERTS program are discussed. It is pointed out that the objectives of ERTS A and B are to assess the practical value of remote sensing from space, to compare the capabilities of spacecraft and aircraft, to determine if and how a space-assisted and user-oriented system should be pursued, to determine which sensors are most effective, and to develop data handling procedures. It is stressed that while there may be international spin-offs, especially for Canada, Mexico, and Brazil, the ERTS A system is primarily an experimental program directed to U.S. requirements. The question of how soon other nations will be prepared to use the data from ERTS A and B and subsequent programs is also discussed. Training programs for persons from

other nations and the costs involved in acquiring and handling data are mentioned. Specific relations with France, India, and the UN, in addition to Canada, Brazil, and Mexico are described.

N.E.N.

N72-23297 Princeton Univ., N.J.

ESTIMATING THE ECONOMIC BENEFIT OF SURVEYING EARTH'S RESOURCES

Klaus P. Heiss *In its Proc. of the Princeton Univ. Conf. on Aerospace Methods for Revealing and Evaluating Earth's Resources* Jun. 1970 13 p

Copyright. Avail: Issuing Activity

Details of the benefit cost analysis are discussed, and the analysis is applied to ERTS-EROS benefit estimates for agriculture and forestry. The estimates include possible prevention of diseases such as wheat rust, prevention of forest fires, and increased yields. The initial estimate of \$36 billion from the ERTS program is considered to be unrealistic. The total increase through more efficient management, crop identification, better forecasting, and early detection of pests and forest fires is shown to be \$240 million.

N.E.N.

N72-23307# Committee on Science and Astronautics (U. S. House).

REMOTE SENSING OF EARTH RESOURCES

1972 233 p ref Presented at the 13th Meeting of the Panel on Science and Technology, 1972

Avail: SOD \$1.25

Present and projected applications of remote sensing to studies of earth resources and the environment are considered. Data acquisition, processing, and dissemination are discussed.

N72-23310# TRW Systems Group, Redondo Beach, Calif.
REQUIREMENTS AND TECHNOLOGY FOR OBSERVATIONS FROM SPACE

A. K. Thiel *In Comm. on Sci. and Astronaut. (U.S. House) Remote Sensing of Earth Resources* 1972 p 43-81

Avail: SOD \$1.25

The capabilities of meteorological satellites in orbit and under development are considered. The objectives for remote sensor data in the late 1970's and early 1980's are discussed. Based on these goals, the types of technological improvement needed are predicted. Some examples are given of the relevance of remote sensing to administrative and legislative objectives.

K.P.D.

N72-23311# General Electric Co., Philadelphia, Pa. Space Div.
CURRENT CAPABILITIES, STATE OF THE TECHNOLOGY, AND FUTURE REQUIREMENTS

Daniel J. Fink *In Comm. on Sci. and Astronaut. (U.S. House) Remote Sensing of Earth Resources* 1972 p 83-91

Avail: SOD \$1.25

Problems of remote sensing are considered; these include environmental monitoring, ocean monitoring, land use and resources management, and information extraction from data. The questions involved in acting upon the data received are discussed.

K.P.D.

N72-23312# Interior Dept., Washington, D.C.

USERS, PROSPECTS, AND PLANS

W. T. Pecora *In Comm. on Sci. and Astronaut. (U.S. House) Remote Sensing of Earth Resources* 1972 p 93-101

Avail: SOD \$1.25

Information needs are listed which can be met by remote sensing techniques. Future technological developments are discussed, and the Earth Resources Observation System and available facilities are reviewed.

K.P.D.

N72-23314# Michigan Univ., Ann Arbor. Willow Run Labs.
THE DEVELOPMENT OF REMOTE SENSING OF EARTH RESOURCES

George J. Zissis *In Comm. on Sci. and Astronaut. (U.S. House) Remote Sensing of Earth Resources* 1972 p 119-128

Avail: SOD \$1.25

The history and principles of remote sensing are presented. Present capabilities and areas of research are considered. K.P.D.

N72-23316# Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).

INTERNATIONAL IMPLICATIONS OF REMOTE SENSING

Norman H. Fisher *In Comm. on Sci. and Astronaut. (U.S. House) Remote Sensing of Earth Resources* 1972 p 137-147 ref

Avail: SOD \$1.25

Applications of remote sensing and implications for mineral exploration are discussed. The lower limit of outer space and the question of national control over air space are considered. Technical assistance to developing countries and the storage and distribution of remote sensing information are also dealt with.

K.P.D.

N72-23317# United Nations Working Group on Remote Sensing of the Earth by Satellites, New York.

THE UNITED NATIONS AND THE REMOTE SENSING OF EARTH RESOURCES

Franco Fiorio (Italian Embassy) *In Comm. on Sci. and Astronaut. (U.S. House) Remote Sensing of Earth Resources* 1972 p 149-156

Avail: SOD \$1.25

The activities of the United Nations Working Group on Remote Sensing of the Earth by Satellite are discussed. K.P.D.

N72-23318# Instituto de Pesquisas Espaciais, Sao Paulo (Brazil).

IMPLICATIONS OF REMOTE SENSING IN THE UNDER-DEVELOPED NATIONS

Fernando DeMendonca *In Comm. on Sci. and Astronaut. (U.S. House) Remote Sensing of Earth Resources* 1972 p 157-163

Avail: SOD \$1.25

The potential benefits that might be derived by underdeveloped countries through remote sensing applications are discussed. It is pointed out that remote sensors applied to agriculture give large-scale and quick benefits in soil research, in crop prediction, and also in the survey of available mineral resources which will contribute to the improvement of the areas and their cultivation. Particular reference is made to Brazil where remote sensing plays an invaluable role in pinpointing pest infected areas of coffee plantations. The various instruments used in remote sensing applications are reviewed and the techniques utilized with the instrumentation are discussed.

D.L.G.

N72-23319# Ministry of Science and Education, Bonn (West Germany).

THE ROLE OF EARTH RESOURCES SATELLITES IN EUROPE

Armin Spaeth *In Comm. on Sci. and Astronaut. (U.S. House) Remote Sensing of Earth Resources* 1972 p 165-167

Avail: SOD \$1.25

An overview is presented of current space projects in the Federal Republic of Germany and of the problems involved in establishing an earth resources satellite program. Limited amounts of funding and the lack of preparatory work are cited as the main obstacles. However, participation in the ERTS A and B program is expected to provide much of the necessary background technology.

D.L.G.

09 GENERAL

N72-23324* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SIGNIFICANT ACCOMPLISHMENTS IN SCIENCES, 1970
 Washington 1972 253 p ref Symp. held at Greenbelt, Md., 14 Jan. 1971 Original contains color illustrations
 (NASA-SP-286) Avail: NTIS HC \$3.00 CSCL 08G

Research papers on earth resources, meteorology, ionosphere, and interplanetary physics are reported.

N72-23409# Entwicklungsring Nord, Bremen (West Germany).
ON EARTH RESOURCES SATELLITE PROJECTS [UEBERLEGUNGEN ZU ERDWISSENSCHAFTLICHEN SATELLITENPROJEKTEN]

H. Krueger Cologne DGLR 1971 15 p In GERMAN
 Presented at the 4th DGLR Ann. Meeting, Baden-Baden, West Ger., 11-13 Oct. 1971 Sponsored by Bundesmin. fuer Bildung und Wiss. Prepared jointly with Dornier-Werke and Standard-Elektrik Lorenz

(DGLR-Paper-71-051) Avail: NTIS HC \$3.00

An approach to a German earth resources satellite is presented. This would include both a meteorological and a geological mission. Two problems are emphasized: (1) the development of a multispectral line-scanner giving good resolution over an area of 100 square kilometers from an altitude of 900 kilometers, and (2) the required data handling transmission capacity and ground based data stations. The general characteristics of the satellite are discussed, and it was found that a slightly modified version of the ESRO TD-1 satellite would be suitable.

Author (ESRO)

N72-24396* Wisconsin Univ., Madison.

APPLICATIONS OF AIRBORNE REMOTE SENSING TECHNOLOGY Journal of the Surveying and Mapping Div.
 Ralph W. Kiefer and James P. Scherz Oct. 1971 26 p refs
 Presented at the ASCE Natl. Meeting on Transportation Eng., Washington, D. C., 21-25 Jul. 1969
 (Grant NGL-50-002-127)

(NASA-CR-126628; Rept-8) Copyright. Avail: Wis. Univ., Madison, 351 Meteorology and Space Sci. Bldg.: HC \$0.50 CSCL 08G

The electromagnetic spectrum and remote sensing instruments are considered. Aerial photographic processes and the applications of aerial photography are discussed. Thermal infrared imagery, multichannel imagery, side-looking airborne radar, and other sensors are described.

K.P.D.

N72-24397* Wisconsin Univ., Madison. Dept. of Civil Engineering.

EFFECTS OF DATE OF PHOTOGRAPHY ON AIRPHOTO INTERPRETATION

Ralph W. Kiefer Nov. 1971 27 p refs Presented at Proc. of the 1970 Intern. Symp. on Photography and Navigation, Columbus, Ohio, 25-28 May 1970

(Grant NGL-50-002-127)

(NASA-CR-126632; Rept-9) Copyright. Avail: Wis. Univ., Madison, 351 Meteorology and Space Sci. Bldg.: HC \$2.00 CSCL 14E

More than 3000 exposures of color and color-infrared film on 35 mm format were taken of selected sites in southern Wisconsin during 1969 from elevations of 2000 to 8000 feet above the terrain. The subject matter included rural terrain (cropland, grazing land, and woodland), lakes (showing weed and algae growth), and river flood plains (showing river flooding and subsequent crop damage). Some of the photographs taken for the purposes of soil studies and flood studies are described. Certain intensive study sites were photographed on as many as 20 different dates during the year. The striking changes in texture, tone, and color that occur from day-to-day and month-to-month at selected sites are illustrated. The results of this research show that there are certain optimum dates during the year for the procurement of aerial photography for interpretive uses and that the optimum date of photography may not be the same for all interpretive uses.

Author

N72-24876# Joint Publications Research Service, Arlington, Va.
SOVIET BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 275

9 May 1972 94 p Transl. into ENGLISH from Russian reports (JPRS-55941) Avail: NTIS HC \$6.75

Summaries and abstracts of Soviet-block newspaper and journal articles are presented on astronomy, meteorology, oceanography, geophysics, upper atmosphere, and space programs.

N72-24983# Tel-Aviv Univ. (Israel). Dept. of Environmental Sciences.

[EARTH ENVIRONMENTAL SCIENCES AND SPACE PHYSICS]

1971 120 p refs

Avail: NTIS HC \$8.00

The scope of scientific activity within the Department of Environmental Sciences encompasses the areas of solid earth geophysics; seismology; meteorology; oceanography; earth resources; ionospheric, space, and planetary physics; environmental pollution; and geophysical instrumentation. Abstracts of the scientific publications by various members of the Department during 1971 are included. The year also witnessed a continued expansion in the activities of the Department. Among the new facilities are the Air Pollution Laboratory, Remote Sensing Laboratory, and Cloud Physics and Atmospheric Electricity Laboratory. These facilities are described, and activities at other laboratories are summarized.

Author

N72-26311# Woods Hole Oceanographic Institution, Mass.

BIBLIOGRAPHY OF TECHNICAL REPORTS, 1971

Cecelia B. Fuglister, comp. Jan. 1972 11 p refs

(WHOI-71-78) Avail: NTIS HC \$3.00

A bibliography of oceanographic technical reports is presented on topics which include underwater acoustics, gravity and seismic surveys, geology and geophysics, ocean circulation, organic and inorganic chemical analyses, statistical methods, instrumentation, hydrography, air water interactions, remote sensing, and paleotectonics.

K.P.D.

N72-26811* National Aeronautics and Space Administration, Washington, D.C.

EARTH RESOURCES TECHNOLOGY SATELLITES A (ERTS-A): PRESS KIT

20 Jul. 1972 99 p

(NASA-TM-X-68489) Avail: NASA Scientific and Technical Information Facility, P. O. Box 33, College Park, Md. 20740 CSCL 22B

The ERTS-A spacecraft, instruments, and mission are described along with the general ERTS program and coordinated interagency activities. The 891-kg ERTS-A is to be launched into a 920-km circular, sun-synchronous, near-polar orbit. The main purpose of the first mission is to demonstrate the usefulness of remote sensing of the earth's surface. This includes determining the most suitable natural and cultural resource and environmental data to acquire, demonstrating acquisition procedures and interpretive techniques, and determining how repetitive, synoptic, multispectral observations can be of economic or social value. The main instruments are return beam vidicon TV cameras, a multispectral scanner subsystem, a data collection system, and wideband tape recorders. Ultimately, the ERTS satellites will provide data to aid studying and planning in the areas of agriculture, forestry, geology, hydrology, oceanography, geography, meteorology, and environmental quality and ecology. All investigators from the United States, 31 other nations, and two international organizations will have access to all data.

N.E.N.

N72-27375* Michigan Univ., Ann Arbor. School of Natural Resources.

REMOTE SENSING OF CHANGES IN MORPHOLOGY AND PHYSIOLOGY OF TREES UNDER STRESS Annual Progress Report No. 4

Charles E. Olson, Jr., Wayne G. Rohde, and Jennifer M. Ward Berkeley, Calif. Calif. Univ. Forestry Remote Sensing Lab.

30 Sep. 1970 32-p refs Prepared for Calif. Univ., Berkeley.
Forestry Remote Sensing Lab. in cooperation with Dept. of Agric.
Forest Serv.
(NASA Order W-12996)
(NASA-CR-127420) Avail: NTIS HC \$3.75 CSCL 02F

Results of continuing studies of forest trees subjected to varying types of stress are reported. Both greenhouse and field studies are included. Greenhouse work with tree seedlings exposed to varying levels of NaCl and CaCl₂ in the soil indicated that, in the initial stages, palisade cells shrink and the amount of air space in the leaf increases. As the severity of damage increases, the cells of the spongy mesophyll shrink and flatten, and the amount of air space in the leaf decreases. Statistical analysis of foliar reflectance and associated moisture content data led to a series of regression equations for predicting foliar moisture content from reflectance data. Equations were calculated for three species, yellow birch (*Betula alleghaniensis* Britton), sugar maple (*Acer saccharum* Marsh.) and white ash (*Fraxinus americana* L.) having multiple correlation coefficients of 0.98, 0.94 and 0.93 respectively. Interpretation of multispectral imagery of the Ann Arbor Forestry Test Site (NASA Site 190) provided evidence that infections of *Fomes annosus* can be detected in the early stages. Infections of two needle cast diseases were also detected in conifer plantations in the test site. A study of automatic interpretation of multispectral scanner imagery for tree species recognition provided encouraging results. Author

N72-27381# European Space Research Organization, Paris (France).

EUROPE AND REMOTE SENSING: CRITICAL CONSIDERATIONS AND FUTURE PERSPECTIVES [L'EUROPE ET LA TELEDETECTION: REFLEXIONS CRITIQUES ET PERSPECTIVES D'AVENIR]

R. Tessier and J. Plevin Rome Mar. 1972 12 p In FRENCH Presented at the 19th Rass. Intern. Elettronica, Nucl. ed Aerospaziale, Rome, Mar. 1972
(SI-5) Avail: NTIS HC \$3.00

The development of remote sensing techniques in Europe and their application to earth resources surveys are discussed. A survey of activities carried out in European countries and through ESRO is presented. It is pointed out that European geophysicists are not sufficiently informed about these techniques due to the fact that they were developed essentially for military applications. A proposal is outlined for a future medium-term European program. ESRO

N72-27386# Centre National de la Recherche Scientifique, Marseilles (France).

TELETERS: REMOTE SENSING AND STUDIES OF EARTH RESOURCES. EXPERIMENT PROPOSAL FOR ADVANCED APPLICATIONS FLIGHT EXPERIMENTS (AAFFEE)

[1970] 70 p Partly in ENGLISH and partly in FRENCH Prepared jointly with Groupe d'Etude des Ressources Terrestres par Teledetection Sponsored by CNES
Avail: NTIS HC \$6.00

An experiment is proposed for the Earth Resources Program which would involve a study and multispectral color survey in the Mediterranean region, Central Africa, and South Pacific of the lithosphere, hydrosphere, and biosphere. The experiment, operational requirements (also in relation to the Skylab program) as well as the equipment envisaged, are described. ESRO

N72-28313# North Carolina State Univ., Raleigh. Dept. of Geosciences.

UTILIZATION OF ERTS-A DATA IN GEOLOGICAL EVALUATION, REGIONAL PLANNING, FOREST MANAGEMENT, AND WATER MANAGEMENT IN NORTH CAROLINA

Charles W. Welby, principal investigator Jul. 1972 1 p Sponsored by NASA
(E72-10005; NASA-CR-127553; GSFC-ID-UN281; ERTS-A-Proposal-18) Avail: NTIS HC \$3.00 CSCL 08G

Author

N72-28314# Tennessee Univ., Knoxville. Dept. of Geography. GEOGRAPHIC APPLICATIONS OF ERTS-A IMAGERY

John B. Behder, principal investigator 28 Jun. 1972 4 p Sponsored by NASA
(E72-10008; NASA-CR-127550; GSFC-ID-UN212) Avail: NTIS HC \$3.00 CSCL 08F

Author

N72-28318# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

ERTS-A INVESTIGATION ER-600

R. Bryan Erb, principal investigator 17 Jul. 1972 8 p (E72-10012; NASA-TM-X-68669; GSFC-ID-NA347) Avail: NTIS HC \$3.00 CSCL 08D

Author

N72-28376# Centre National d'Etudes Spatiales, Bretigny-sur-Orge (France).

REMOTE SENSING OF EARTH RESOURCES [LA TELEDETECTION DES RESSOURCES NATURELLES]

Oct. 1971 425 p refs Partly in ENGLISH and partly in FRENCH Proc. of Conf. held in Paris, 26-27 Oct. 1971
Avail: NTIS HC \$23.25

Results and findings on earth resources performed during remote sensing of French territory are presented. Selected studies in the fields of ecology, ground truth terrain analysis, soil mapping, crop growth, infrared imagery, and balloon sounding are described.

N72-28377 Centre National d'Etudes Spatiales, Bretigny-sur-Orge (France).

THE 1970-1971 CNES REMOTE SENSING PROGRAM [LE PROGRAMME CNES DE TELEDETECTION EN 1970-1971]

A. Alouges In its Remote Sensing of Earth Resources Oct. 1971 p 0-6 In FRENCH

The CNES program for the years 1970 and 1971 on remote sensing of earth resources in France is presented. Criteria for selection of sensors, sites, and periods are reviewed. Results obtained during a stratospheric balloon flight are given. Remote sensing techniques are evaluated for the visualization of water movements, which are important in water pollution detection, and for vegetation and soil studies. ESRO

N72-29297# Department of Energy, Mines and Resources, Ottawa (Ontario).

RECOMMENDED NATIONAL PROGRAM FOR REMOTE SENSING

[1972] 14 p
Avail: NTIS HC \$3.00

The recommended program for remote sensing is presented. The elements of the program discussed include: ground readout station, ground data handling centers, air photo library, remote sensing program, international cooperation, and Canadian resource satellite development. F.O.S.

N72-29302# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

FOURTH ANNUAL EARTH RESOURCES PROGRAM REVIEW. VOLUME 1: NATIONAL AERONAUTICS AND SPACE ADMINISTRATION PROGRAMS

21 Jan. 1972 509 p refs Rev. held at Houston, Tex.; 17-21 Jan. 1972 Original contains color illustrations
(NASA-TM-X-68564; MSC-05937-Vol-1) Avail: NTIS HC \$27.50 CSCL 08G

Various aspects of the Earth Resources Program are reviewed with particular emphasis placed on the results of analysis of data obtained with the Manned Spacecraft Center and other aircraft which have contributed to the program. Volume 1 covers NASA programs in the disciplinary areas of geology, geography, hydrology, agriculture, forestry, and oceanography.

N72-29303# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

09 GENERAL

AMES RESEARCH CENTER SR&T PROGRAM AND EARTH OBSERVATIONS

I. G. Poppoff *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 35 p

CSCL 08H

An overview is presented of the research activities in earth observations at Ames Research Center. Most of the tasks involve the use of research aircraft platforms. The program is also directed toward the use of the Illiac 4 computer for statistical analysis. Most tasks are weighted toward Pacific coast and Pacific basin problems with emphasis on water applications, air applications, animal migration studies, and geophysics. A.L.

N72-29312* National Aeronautics and Space Administration. Mississippi Test Facility, Bay Saint Louis.

A SUMMARY OF ACTIVITIES OF THE EARTH RESOURCES LABORATORY AT THE MISSISSIPPI TEST FACILITY DURING 1971

c11
Robert O. Piland *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 19 p

CSCL 14B

First year activities at the NASA Earth Resources Laboratory are reviewed. Covered are: (1) personnel; (2) organization; (3) technical equipment capabilities; (4) University programs; (5) agency relationships; (6) minor projects; (7) technical program; and (8) 1971 reports and products. A.L.

N72-29317* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

LEWIS RESEARCH CENTER EARTH RESOURCES PROGRAM

Herman Mark *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 21 p

CSCL 08L

The Lewis Research Center earth resources program efforts are in the areas of: (1) monitoring and rapid evaluation of water quality; (2) determining ice-type and ice coverage distribution to aid operations in a possible extension of the Great Lakes ice navigation and shipping season; (3) monitoring spread of crop viruses; and (4) extent of damage to strip mined areas as well as success of efforts to rehabilitate such areas for agriculture.

Author

N72-29321* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

APPLICATIONS EXPERIMENTS IN THE HOUSTON REGION

Bryan R. Erb *In its* 4th Ann. Earth Resources Program Rev., Vol. 1 21 Jan. 1972 20 p Original contains color illustrations

CSCL 08H

Organization, staffing, and planning for experimental applications of remote sensing data to gain land use and water management information are described. Work was started on an experimental data base, aerial multispectral photography, and forest and wild life surveys as part of a regional inventory and monitory program. G.G.

N72-29327*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

FOURTH ANNUAL EARTH RESOURCES PROGRAM REVIEW. VOLUME 2: UNIVERSITY PROGRAMS

21 Jan. 1972 608 p refs Rev. held in Houston, Tex., 17-21 Jan. 1972 Original contains color illustrations

(NASA-TM-X-68397; MSC-05937-Vol-2) Avail: NTIS HC \$30.50 CSCL 08G

University research work for the Earth Resources Program centered on automatic data processing techniques to extract information from multispectral scanner data on remotely sensed objects of user interest; water management, crop identification, land use, and environmental pollution aspects were emphasized.

N72-29340* California Univ., Berkeley. Space Sciences Lab. AN INTEGRATED STUDY OF EARTH RESOURCES IN THE STATE OF CALIFORNIA USING REMOTE SENSING TECHNIQUES

c14
Robert N. Colwell *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 24 p refs
CSCL 14B

Remote sensing activities for the management of California's water project are reported. Integrated efforts are based largely on airborne remote sensing data processing to inventory the various kinds of earth resources observed. Work centered on defining parameters pertinent to determine water yield and discernible through remote sensing techniques; (2) determining accuracy in measuring and mapping parameters using remote sensing data flown to various specifications; and (3) relating water yield predictions to actual water yields. Remote sensing imagery of the Perris valley shows that land developers established a number of locations to promote present agricultural land for non-agricultural land use. G.G.

N72-29341* South Dakota State Univ., Brookings. Remote Sensing Inst.

REMOTE SENSING OF SOILS, LAND FORMS, AND LAND USE IN THE NORTHERN GREAT PLAINS IN PREPARATION FOR ERTS APPLICATIONS

C. J. Frazee, F. C. Westin, J. Gropper, and V. I. Myers *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 27 p refs Original contains color illustrations.

(Grant NGL-42-003-007)

(RSI-72-02; J-Ser-1070) CSCL 08M

Research to determine the optimum time or season for obtaining imagery to identify and map soil limitations was conducted in the proposed Oahe irrigation project area in South Dakota. The optimum time for securing photographs or imagery is when the soil surface patterns are most apparent. For cultivated areas similar to the study area, May is the optimum time. The fields are cultivated or the planted crop has not yet masked soil surface features. Soil limitations in 59 percent of the field of the flight line could be mapped using the above criteria. The remaining fields cannot be mapped because the vegetation or growing crops do not express features related to soil differences. This suggests that imagery from more than one year is necessary to map completely the soil limitations of Oahe area by remote sensing techniques. Imagery from the other times studied is not suitable for identifying and mapping soil limitations because the vegetative cover masked the soil surface and does not reflect soil differences. Author

N72-29344* Texas A&M Univ., College Station. Remote Sensing Center.

A COACTIVE INTERDISCIPLINARY RESEARCH PROGRAM WITH NASA

c08
John W. Rouse, Jr. *In* NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 29 p

CSCL 09B

The applications area of the Texas A&M University remote sensing program consists of a series of coactive projects with NASA/MSC personnel. In each case, the Remote Sensing Center has served to complement and enhance the research capability within the Manned Spacecraft Center. In addition to the applications study area, the Texas A&M University program includes coordinated projects in sensors and data analysis. Under the sensors area, an extensive experimental study of microwave radiometry for soil moisture determination established the effect of soil moisture on the measured brightness temperature for several different soil types. The data analysis area included a project in which ERTS-A and Skylab data were simulated using aircraft multispectral scanner measurements at two altitudes. This effort resulted in development of a library of computer

programs which provides an operational capability in classification analysis of multispectral data. Author

N72-29352* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
OVERVIEW OF THE EARTH RESOURCES PROGRAM OF THE JET PROPULSION LABORATORY

Donald P. Burcham / In NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 2 21 Jan. 1972 3 p

CSCL 08G

Proposed is an investigation to develop and correlate remote sensing from satellites and aircraft into an effective prototype system for California statewide water quality surveillance. Aircraft overflights, computer enhanced recognition of pollution signatures, ground truth measurements, and data processing will be employed to develop a simplified and automated monitoring system. ERTS A image data will be used for nine major drainage basins of California having unique water quality influences from waste discharges, thermal contributions, oil spills, turbidity, sea water intrusion, agricultural drainage, toxicity, biostimulation, and eutrophication. Author

N72-29360* Arizona Univ., Tucson. Office of Arid Land Studies.
FUNCTIONS AND ACTIVITIES OF THE ARIZONA REGIONAL ECOLOGICAL TEST SITE

L. K. Lepley / In NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 6 p.

CSCL 08G

The Arizona Regional Ecological Test Site (ARETS) project and its efforts to coordinate and transfer satellite remote sensing techniques to solving earth resources and environmental problems in the Arizona area are discussed. Project objectives include: (1) establishing a multidiscipline resources and environment team in Arizona capable of applying satellite and supporting aircraft data to expedite remote sensing technology transfer to user agencies; (2) determine future resources and environment information needs for Arizona; (3) conduct coordinated multidiscipline experiments in the use of ERTS data; and (4) provide and recommend facilities, instruments, and training necessary to support the practical uses of remote sensing data. Author

N72-29361* Geological Survey, Phoenix, Ariz. Water Resources Div.
APPLICATIONS OF REMOTE SENSOR DATA BY STATE AND FEDERAL USER AGENCIES IN ARIZONA

Herbert H. Schumann / In NASA. Manned Spacecraft Center 4th Ann. Earth Resources Program Rev., Vol. 3 21 Jan. 1972 10 p

CSCL 08G

The use of NASA high altitude aerial photography of south eastern Arizona to develop a natural resources information system for Federal lands is discussed. The data are to be used by local, State, and Federal agencies in connection with geologic mapping projects, water resources investigations, and land use studies to determine the alignment of a proposed major aqueduct. In addition, the data are used to confirm land ownership boundaries, detect changes in land use, and legislative reapportionment mapping. Other applications include mapping vegetative cover, evaluation of changes in wildlife habitat, location of deer kills, and as a base for recording telemetry data from radio-collared big game animals. Author

N72-29378* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
FOURTH ANNUAL EARTH RESOURCES PROGRAM REVIEW. VOLUME 4: NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION PROGRAMS AND US NAVAL RESEARCH LABORATORY PROGRAMS

21 Jan. 1972 451 p refs Rev. held at Houston, Tex., 17-21 Jan. 1972 Original contains color illustrations (NASA-TM-X-68563; MSC-05937-Vol-4) Avail: NTIS HC \$24.75 CSCL 08E

The Earth Resources Program is reviewed. Papers in the following disciplinary areas are included: geology, geography, hydrology, agriculture, forestry, and oceanography.

N72-29848# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE ROAD TO ORBITAL STATIONS

L. A. Lebedev [1972] 44 p Transl. into ENGLISH from Ser. Kosmonav. Astron., USSR, no. 11, 1971

Avail: NTIS HC \$4.25; National Translations Center, John Crerar Library, Chicago, Ill. 60616 CSCL 22C

Experience gained during Soviet space flights leading up to orbital space stations is described, along with the value of space stations to science and technology. The stages in rendezvous and docking of a manned spacecraft with an unmanned satellite are delineated, and the importance of these maneuvers for space station operations is stressed. Results of experiments on Soyuz and Salyut flights are discussed, including astronomical, biomedical, spacecraft maneuvering, and IVA experiments. Emphasis is on the group flight with Soyuz 6, Soyuz 7, and Soyuz 8, and on the Soyuz 9 and Salyut flights. The problems potentially solvable by space station operations are divided into four groups associated with the following: study of the earth; study of the solar system, galaxies, and remote areas of the universe; science-technology and production-engineering aspects related to the spacecraft environment; and the station as a link between earth and other areas of the solar system, such as an interplanetary communication link. N.E.N.

N72-31285# Interdepartmental Committee on Resource Satellites and Remote Airborne Sensing, Ottawa (Ontario).
ORGANIZATION FOR A NATIONAL PROGRAM ON REMOTE SENSING OF THE SURFACE ENVIRONMENT (A WORKING PAPER)

L. W. Morley 16 Oct. 1970 57 p

Avail: NTIS HC \$5.00

A Remote Sensing Center is proposed within the federal government to provide technical and management coordination of a national remote sensing program. The center would be responsible for long range planning, for definition and coordination of requirements, and for undertaking projects in support of approved program plans. It would be expected to acquire and develop expertise in the principal areas of remote sensing activity, including data collection, processing, and interpretation, and would initiate and carry out research in these areas. The proposed Remote Sensing Center would be organized in five principal elements which carry out the functions of planning (Program Planning Office), data collection (Data Acquisition Division), data processing and distribution (Data Processing Division), and data interpretation research (Data Interpretation Division). Co-location of these organizational elements is recommended to facilitate communications and maximize efficiency in use of facilities, equipment and personnel. The proposed organization permits growth, as new requirements are introduced, without major re-structuring. Author

N72-31336* Geological Survey, Washington, D.C. Information Office.
ERTS PHOTOGRAPHY ALREADY USEFUL

James F. Daniel, Principal Investigator, Alden P. Colvocoresses, Principal Investigator, James R. Wray, Principal Investigator, and William D. Carter 29 Sep. 1972 3 p Presented as Preliminary Findings from Analyses of ERTS Observations, NASA Goddard Space Flight Center, Greenbelt, Md., 29 Sep. 1972 Sponsored by NASA Original contains color illustrations. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S.D. 57198

(E72-10045) Avail: NTIS HC \$3.00 CSCL 08G

N72-31373# Canadian Aeronautics and Space Inst., Toronto (Ontario).
CANADA'S ROLE IN REMOTE SENSING

15 Mar. 1971 18 p

Avail: NTIS HC \$3.00

09 GENERAL

The implications for Canada of the technology of remote sensing from Earth Resources Technology Satellites and aircraft are discussed. Brief analyses of sovereignty problems, Canada's proposed role in remote sensing, and the potential benefits are included. F.O.S.

N72-31378# Department of Energy, Mines and Resources, Ottawa (Ontario). Program Planning Office.

THE NASA ERTS SYSTEM AND POTENTIAL COVERAGE OF CANADA

R. O. Chipman [1971] 6 p
 Avail: NTIS HC \$3.00

Plans to orbit an Earth Resources Technology Satellite (ERTS) to provide high resolution images of the earth on a repetitive basis are discussed. The launching of the first satellite, ERTS-A, is scheduled for March of 1972, to be followed about one year later by an almost identical ERTS-B. The satellite will be placed in a circular, near polar sun-synchronous orbit at an altitude of 910 km and will carry four sensors, three return beam vidicon (RBV) cameras, identical except for spectral filters, and a four-channel multispectral scanner, all of which will cover the same 185 km wide swath along the ground track, the vidicons taking a series of snapshots and the scanner scanning continuously. The ground resolution is expected to be 80 to 150 m per line pair. The imagery can be recorded in the satellite for later transmission or transmitted directly to a ground receiving station where it will be recorded and sent to a central data handling center to be transformed into hard copy (photography). Corrections to make the imagery conform geometrically with existing maps will then be made, and the images, in color or black and white, will be sent directly to users or to specialized data interpretation centres. The satellite will also have the capability of relaying data from remote automatic ground platforms, such as stream or tide gauges, etc., to the receiving station on a daily basis. Author

N72-31382# Manitoba Ad Hoc Committee on Resource Satellites and Remote Airborne Sensing, Winnipeg.
EVALUATION OF 1971 REMOTE SENSING ACTIVITY IN MANITOBA

Charles Tarnocai 22 Dec. 1971 63 p refs
 Avail: NTIS HC \$5.25

The Canadian Federal Agriculture and Geography working group on resource satellite and airborne remote sensing selected a number of ground truth test areas in various regions of Canada. In Manitoba the following three test areas were chosen: the Neepawa area, the Thompson-The Pas area, and the Churchill area. In addition to these, the Carroll Lake test area was added in 1971. It is anticipated that these sites will provide sample areas for collecting ground truth information relating to imagery from resource satellites, such as the ERTS A and B. To compliment the resource satellite imagery to be obtained beginning in 1972, an airborne remote sensing program was started by the Remote Sensing Centre. Four provincial remote sensing working groups were established under the broad headings of geology, land, vegetation, and water in the spring of 1971. These working groups, with assistance from the Manitoba ad hoc Committee, organized the ground truth investigations, formulated photo specifications, and in the fall, when the imagery became available, started interpretation of the data.

Author

N72-32344# Bureau of Reclamation, Denver, Colo.
APPLICATION OF REMOTE SENSING TO SELECTED BUREAU OF RECLAMATION PROJECTS Progress Report, 1 Jul. - 31 Aug. 1972

Larry D. Cast, Principal Investigator 8 Sep. 1972 2 p
 Sponsored by NASA
 (E72-10091; NASA-CR-128140) Avail: NTIS HC \$3.00 CSCL 08G

N72-32379# Alaska Univ., College. Dept. of Geology.
ERTS-1 DATA AS A TEACHING AND RESEARCH TOOL IN THE DEPARTMENT OF GEOLOGY. Bimonthly Progress Report

Donald Grybeck, Principal Investigator 30 Sep. 1972 2 p

Sponsored by NASA
 (E72-10131; NASA-CR-128185; BMPR-1) Avail: NTIS HC \$3.00 CSCL 08G

N72-32959# Committee on Space Research (COSPAR), Paris (France).

COSPAR INFORMATION BULLETIN NO. 62

A. C. Stickland, ed. Jun. 1972 57 p refs Partly in ENGLISH; partly in FRENCH

Avail: NTIS

Information on future meetings, including an international conference on launching bases, and other meetings of interest to COSPAR, is presented. International cooperative programs, the International Information Bureau on Astronomical Ephemerides; 1971 French space activities, determination of radius vectors of an earth satellite, a survey of satellites and space probes, space radiobiology and radiation safety, and the special meeting of the working group on applications of space techniques to meteorology and earth survey are also discussed. K.P.D.

N72-32967# Committee on Science and Astronautics (U. S. House).

FOR THE BENEFIT OF ALL MANKIND The Practical Returns from Space Investment

George P. Miller Washington GPO Oct. 1972 83 p refs
 Presented by the Comm. on Sci. and Astronaut. to the Comm. of the Whole House on the State of the Union, 92d Congr., 2d Sess., 27 Sep. 1972

(H-Rept-92-1452) Avail: US Capitol, House Document Room

An updated and expanded report on the subject of the spinoff dividends accruing from space exploration is presented. Statements on the broad values of the space program by persons in responsible positions and by the press are given. Tangible benefits are described in the following areas: communications, weather forecasting, business and industry, management, agriculture, the environment, aeronautics, education, medicine, home and marketplace, municipal and urban affairs, and benefits abroad. Expected benefits in the future are also mentioned. N.E.N.

N72-32974# Wisconsin Univ., Madison. Space Science and Engineering Center.

MULTIDISCIPLINARY STUDIES OF THE SOCIAL, ECONOMIC AND POLITICAL IMPACT RESULTING FROM RECENT ADVANCES IN SATELLITE METEOROLOGY, VOLUME 1 Interim Report

Jun. 1971 478 p refs

(Grant NGL-50-002-114)

(NASA-CR-127335) Avail: NTIS HC \$26.00 CSCL 05K

The multidisciplinary studies explore and evaluate the impact of the meteorological satellite and the concomitant impact of the data derived from it on various user groups. As expected, the primary impact related to those who would use satellite data for weather prediction and related purposes. A secondary impact was in the area of international concerns where GARP and other international meteorological activities were affected and international law was developed. A tertiary impact was exemplified by satellite photographs utilized in advertisements and related materials. The case studies, supporting studies, and independent studies all emphasize the potential of the meteorological satellite. Author

N72-32975# Wisconsin Univ., Madison. Space Science and Engineering Center.

MULTIDISCIPLINARY STUDIES OF THE SOCIAL, ECONOMIC AND POLITICAL IMPACT RESULTING FROM RECENT ADVANCES IN SATELLITE METEOROLOGY, VOLUME 2 Interim Report

Jun. 1971 449 p refs

(Grant NGL-50-002-114)

(NASA-CR-127336) Avail: NTIS HC \$24.50 CSCL 05K

The multidisciplinary studies explore and evaluate the impact of the meteorological satellite and the concomitant

impact of the data derived from it on various user groups. As expected, the primary impact related to those who would use satellite data for weather prediction and related purposes. A secondary impact was in the area of international concerns where GARP and other international meteorological activities were affected and international law was developed. A tertiary impact was exemplified by satellite photographs utilized in advertisements and related materials. The case studies, supporting studies, and independent studies all emphasize the potential of the meteorological satellite. Author

N72-33303* Ohio Dept. of Economic and Community Development, Columbus.

RELEVANCE OF ERTS TO THE STATE OF OHIO Progress Report, Aug. - Sep. 1972

David C. Sweet, Principal Investigator Sep. 1972 6 p Prepared for Battelle Columbus Labs., Ohio.

(Contracts NAS5-21782; BCL-72-17/G-1793)

(E72-10144; NASA-CR-127329) Avail: NTIS HC \$3.00 CSCL 08B

N72-33304* Earth Satellite Corp., Berkeley, Calif.

A SCHEME FOR THE UNIFORM MAPPING AND MONITORING OF EARTH RESOURCES AND ENVIRONMENTAL COMPLEXES USING ERTS-1 IMAGERY Progress Report, 15 Jun. - 31 Aug. 1972

Charles E. Poulton, Principal Investigator and Robin I. Welch 20 Sep. 1972 6 p Sponsored by NASA

(E72-10145; NASA-CR-127330; PR-1) Avail: NTIS HC \$3.00 CSCL 08B

N72-33306* National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.

UTILIZATION OF ERTS-1 DATA IN THE HOUSTON AREA Progress Report, Jul. - Aug. 1972

R. Bryan Erb, Principal Investigator 21 Sep. 1972 4 p

(E72-10148; NASA-TM-X-68627) Avail: NTIS HC \$3.00 CSCL 08F

N72-33312* Earth Satellite Corp., Washington, D.C.

INVESTIGATION OF APPLICATION OF ERTS-1 DATA TO INTEGRATED STATE PLANNING IN MARYLAND Interim Report, 22 Jun. - 30 Sep. 1972

Kurt Hecht, Principal Investigator 30 Sep. 1972 18 p Prepared for Md. Dept. of State Planning

(Contract NAS5-21779)

(E72-10154; NASA-CR-128290) Avail: NTIS HC \$3.00 CSCL 05A

N72-33780* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

SIGNIFICANT ACCOMPLISHMENTS IN SCIENCES, 1971

Jun. 1972 220 p refs Symp. held at Greenbelt, Md., 10 Nov. 1971

(NASA-TM-X-66034; X-601-72-218) Avail: NTIS HC \$13.00 CSCL 14B

The proceedings of a conference on aerospace sciences conducted at the Goddard Space Flight Center on 10 November, 1971 are presented. The subjects discussed include: (1) soil moisture measurements with microwave radiometers, (2) Arctic ice measurements with microwave radiometers, (3) measurements of ocean color, (4) studies with satellite radiometer data, (5) the global hydrogen budget, (6) solar radio bursts, (7) transport of cosmic rays in the solar corona, and (8) interplanetary dust and comet orbits.

N73-10348* North Carolina State Univ., Raleigh. Dept. of Geosciences.

UTILIZATION OF ERTS-1 DATA IN GEOLOGICAL EVALUATION, REGIONAL PLANNING, FOREST MANAGEMENT,

AND WATER MANAGEMENT IN NORTH CAROLINA

Charles W. Welby, Principal Investigator Sep. 1972 1 p Sponsored by NASA

(E72-10167; NASA-CR-128351) Avail: NTIS HC \$3.00 CSCL 08H

N73-10364* Earth Satellite Corp., Berkeley, Calif.

A SCHEME FOR THE UNIFORM MAPPING AND MONITORING OF EARTH RESOURCES AND ENVIRONMENTAL COMPLEXES USING ERTS-1 IMAGERY Progress Report, 1 Sep. - 31 Oct. 1972

Charles E. Poulton, Principal Investigator and Robin I. Welch 10 Nov. 1972 6 p Sponsored by NASA

(E72-10185; NASA-CR-128383; PR-2) Avail: NTIS HC \$3.00 CSCL 08B

N73-10399* Auburn Univ., Ala. School of Engineering.

ERISTAR: EARTH RESOURCES INFORMATION STORAGE, TRANSFORMATION, ANALYSIS, AND RETRIEVAL Final Report

Sep. 1972 436 p refs

(Grant NGT-01-003-044)

(NASA-CR-61392) Avail: NTIS HC \$24.00 CSCL 05B

The National Aeronautics and Space Administration (NASA) and the American Society for Engineering Education (ASEE) have sponsored faculty fellowship programs in systems engineering design for the past several years. During the summer of 1972 four such programs were conducted by NASA, with Auburn University cooperating with Marshall Space Flight Center (MSFC). The subject for the Auburn-MSFC design group was ERISTAR, an acronym for Earth Resources Information Storage, Transformation, Analysis and Retrieval, which represents an earth resources information management network of state information centers administered by the respective states and linked to federally administered regional centers and a national center. The considerations for serving the users and the considerations that must be given to processing data from a variety of sources are described. The combination of these elements into a national network is discussed and an implementation plan is proposed for a prototype state information center. The compatibility of the proposed plan with the Department of Interior plan, RALI, is indicated. Author

N73-10599 National Lending Library for Science and Technology, Boston Spa (England).

METEORS ON WATCH: SCIENCE EXTENDS ITS VISTAS

I. Andronov [1972] 5 p Transl. into ENGLISH from Pravda (USSR), 25 May 1972

(NLL-M-22683-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.; 1 NLL photocopy coupon

The Soviet Meteor meteorological space system is described and its capabilities in the fields of weather forecasting, geological surveying, and exploration of earth resources are briefly outlined. A.L.

N73-12358* Ohio Dept. of Economic and Community Development, Columbus.

RELEVANCE OF ERTS TO THE STATE OF OHIO Progress Report, Oct. - Nov. 1972

David C. Sweet, Principal Investigator Nov. 1972 7 p Prepared for Battelle Columbus Labs. Original contains imagery. Original photography may be purchased from EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(Contract NAS5-21782; BCL-72-17/G-1793)

(E72-10259; NASA-CR-129191) Avail: NTIS HC \$3.00 CSCL 08I

The author has identified the following significant results. The ability to delineate and inventory strip mined areas using ERTS-1 imagery has been established. This gives Ohio a method to rapidly gain an up-to-date inventory of strip mined lands for state planning purposes, which has not been available previously. Smoke plume detection and sedimentation patterns in Sandusky Bay have also been determined from initial analysis of ERTS-1 data.

09 GENERAL

N73-12378*# North Carolina State Univ., Raleigh. Dept. of Geosciences.

UTILIZATION OF ERTS-A DATA IN GEOLOGICAL EVALUATION, REGIONAL PLANNING, FOREST MANAGEMENT, AND WATER MANAGEMENT IN NORTH CAROLINA

Charles W. Welby, Principal Investigator 30 Nov. 1972 3 p (Contract NAS5-21732)
(E72-10280; NASA-CR-129250) Avail: NTIS HC \$3.00 CSCI 08H

N73-13337*# Arizona Univ., Tucson. Dept. of Watershed Management.

USE OF EARTH RESOURCES TECHNOLOGICAL SATELLITE (ERTS) DATA IN A NATURAL RESOURCE INVENTORY Progress Report, 1 Oct. - 30 Nov. 1972

Ernest B. Fish, Principal Investigator 7 Dec. 1972 2 p (Contract NAS5-21820)
(E72-10287; NASA-CR-129277) Avail: NTIS HC \$3.00 CSCI 08F

N73-13348*# National Research Council, Bangkok (Thailand). **THE THAILAND PROGRAMME OF EARTH RESOURCES TECHNOLOGY SATELLITE Progress Report**

Pradisth Cheosakul, Principal Investigator 18 Dec. 1972 3 p Sponsored by NASA
(E72-10298; NASA-CR-129544) Avail: NTIS HC \$3.00 CSCI 08F

The author has identified the following significant results. Multispectral scanner image quality is considered excellent. It is immediately apparent that details of the coastline, water courses, and many other features readily apparent in the imagery will permit important updating and correction of available maps of Thailand.

N73-13354*# Kansas Univ., Lawrence. Space Technology Labs. **KANSAS ENVIRONMENTAL AND RESOURCE STUDY: A GREAT PLAINS MODEL, TASKS 1-6 Progress Report, period ending 30 Nov. 1972**

Robert M. Haralick, Edward T. Kanemasu, Stanley A. Morain, Harold L. Yarger, Principal Investigators, Fawwaz T. Ulaby, K. Sam Shanmugam, Donald L. Williams, James R. McCauley, and James L. McNaughton 30 Nov. 1972 77 p (Contract NAS5-21822)

(E72-10305; NASA-CR-129554) Avail: NTIS HC \$6.00 CSCI 08F

There are no author identified significant results in this report. Environmental and resources investigations in Kansas utilizing ERTS-1 imagery are summarized for the following areas: (1) use of feature extraction technique for texture context information in ERTS imagery; (2) interpretation and automatic image enhancement; (3) water use, production, and disease detection and predictions for wheat; (4) ERTS-1 agricultural statistics; (5) monitoring fresh water resources; and (6) ground pattern analysis in the Great Plains. A.L.

N73-13362*# Michigan State Univ., East Lansing. **USE OF ERTS DATA FOR A MULTIDISCIPLINARY ANALYSIS OF MICHIGAN RESOURCES Status Report**

Axel L. Anderson, Principal Investigator, Wayne L. Myers, A. H. Ellingbroe, and E. P. Whiteside 1 Dec. 1972 9 p (Contract NAS5-21834)
(E72-10313; NASA-CR-129562) Avail: NTIS HC \$3.00 CSCI 08G

N73-13366*# North Carolina State Univ., Raleigh. **UTILIZATION OF ERTS-1 DATA IN NORTH CAROLINA Interim Report, May - Nov. 1972**

Charles W. Welby, Principal Investigator, J. O. Lammi, and R. J. Carson Dec. 1972 8 p (Contract NAS5-21732)
(E72-10317; NASA-CR-129575) Avail: NTIS HC \$3.00 CSCI 08F

The author has identified the following significant results. Initial study and interpretation of ERTS-1 imagery indicates its usefulness for regional land use planning purposes in North

Carolina. Quarries, many secondary roads, and the existence of urbanization as well as changes in urban areas may be mapped. Differences in spectral response for various parts of the major cities suggests that the type of activity in urbanized areas may be monitored. Geological mapping at a scale of 1:250,000 may be possible. The major unfavorable comment from various organizations and agencies who are potential users has been to the relatively small scale. The imagery is a powerful illustrative tool for the several state agencies cooperating in the investigation.

N73-13829*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

SPACE FOR MANKIND'S BENEFIT

Jesco VonPuttkamer, ed. and Thomas J. McCullough, ed. Washington 1972 415 p refs A Space Congr. held at Huntsville, Ala., 15-19 Nov. 1971; sponsored by the Huntsville Assoc. of Tech. Soc. Original contains color illustrations
(NASA-SP-313; LC-72-600226) Avail: NTIS; SOD \$4.50 CSCI 03B

The proceedings of a space congress held at Huntsville, Alabama during November 1971 are presented. The theme of the conference was Space for Mankind's Benefit. The subjects discussed were: (1) man in near-earth space, (2) fundamental benefits of the space program, (3) benefits of orbital surveys and space technology to environmental protection, (4) benefits to telecommunications, navigation and information systems, (5) benefits to future power generations and energy production, and (6) general technology utilization in the public sector.

N73-13830*# TRW Systems Group, Redondo Beach, Calif.

UNMANNED SPACECRAFT FOR RESEARCH

Carl D. Graves In NASA. Marshall Space Flight Center Space for Mankind's Benefit 1972 p 23-39 Original contains color illustrations
CSCI 22B

The applications of unmanned spacecraft for research purposes are discussed. Specific applications of the Communication and Navigation satellites and the Earth Observations satellites are described. Diagrams of communications on world-wide basis using synchronous satellites are developed. Photographs of earth resources and geology obtained from space vehicles are included. P.N.F.

N73-14329*# Alaska Univ., College.

COORDINATION AND ESTABLISHMENT OF CENTRALIZED FACILITIES AND SERVICES FOR THE UNIVERSITY OF ALASKA ERTS SURVEY OF THE ALASKAN ENVIRONMENT Bimonthly Progress Report

Albert E. Belon, Principal Investigator 30 Nov. 1972 10 p (Contract NAS5-21833)
(E72-10341; NASA-CR-129655; BMPR-2) Avail: NTIS HC \$3.00 CSCI 14B

N73-14341*# Alaska Univ., College.

ERTS-A DATA AS A TEACHING AND RESEARCH TOOL IN THE DEPARTMENT OF GEOLOGY Bimonthly Progress Report

Donald Grybeck, Principal Investigator 20 Dec. 1972 1 p (Contract NAS5-21833)
(E72-10353; NASA-CR-129666; BMPR-2) Avail: NTIS HC \$3.00 CSCI 08G

N73-14361*# California Univ., Berkeley. Space Sciences Lab. **AN INTEGRATED STUDY OF EARTH RESOURCES IN THE STATE OF CALIFORNIA USING REMOTE SENSING TECHNIQUES Annual Progress Report, 1972**

Robert N. Colwell 1 May 1972 482 p refs Original contains color illustrations
(Grant NGL-05-003-404)
(NASA-CR-129987) Avail: NTIS HC \$26.25 CSCI 08F

The management of California's earth resources using aerial and space remote sensing techniques is discussed. Specific summaries cover land use, California State Water Project, water resource management, and techniques and equipment for utilizing

remote sensing data. The socio-economic factors associated with earth resources are discussed.

N73-14362* California Univ., Berkeley.

AN INTEGRATED STUDY OF EARTH RESOURCES IN THE STATE OF CALIFORNIA USING REMOTE SENSING TECHNIQUES: INTRODUCTION

Robert N. Colwell *In its* An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Techniques 1 May 1972 9 p
CSCL 08F

A study of California's water project by remote procedures is presented. The program is designed to acquire data, analyze the data, and effect means by which the data may be used most effectively. E.H.W.

N73-14363* California Univ., Berkeley. Social Sciences Group.
DEFINITION OF EARTH RESOURCES POLICY AND MANAGEMENT PROBLEMS IN CALIFORNIA

C. West Churchman *In its* An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Techniques 1 May 1972 123 p refs
CSCL 05A

The activities of the Social Sciences Group in solving earth resources management problems as related to social factors, are reported. Major efforts of the Group revolved around identifying potential users of ERTS data, ascertain the user's needs, and assay the organizational impacts of new and technologically advanced sources of information. Attempts were also made to develop a linear programming model to be used in decision making with respect to resources being observed by ERTS and other remote sensing vehicles. The cost effectiveness of solving these management problems is discussed. E.H.W.

N73-14379# Swedish Natural Science Research Council, Stockholm.

GLOBAL ENVIRONMENTAL MONITORING SYSTEM

B. Lundholm and S. Svensson 1970 66 p
(Bull-10) Avail: NTIS HC \$5.50

The biosphere is separated into atmosphere, hydrosphere, and pedosphere. Each of these components is discussed and a series of recommendations list the most informative parameters for showing secular trends by monitoring. Living organisms are discussed under the headings organosphere and biological parameters. Although special attention is paid to these, particularly insofar as they affect man, it is considered that too little is known at present to allow the formulation of comprehensive recommendations for biota. It is suggested that using international cooperation, pilot activities are started to review critically and select the appropriate parameters, in particular, biological variables. Author

N73-14938* Auburn Univ., Ala.

THE 1972 NASA ASEE SUMMER FACULTY FELLOWSHIP PROGRAM: RESEARCH REPORTS

J. Fred OBrien, Jr., Donald C. Raney, and Marion I. Kent Sep. 1972 676 p refs Prepared in cooperation with Alabama Univ., University Sponsored in part by Am. Soc. of Eng. Educ. (Grant NGT-01-003-045)
(NASA-CR-61396) Avail: NTIS HC \$36.00 CSCL 05B

Documented research is reported on various projects, ranging from crystal growth to remote sensors to air pollution to mass urban transportation.

N73-15642* Wisconsin Univ., Madison. Space Science and Engineering Center.

MULTIDISCIPLINARY STUDIES OF THE SOCIAL ECONOMIC AND POLITICAL IMPACT RESULTING FROM RECENT ADVANCES IN SATELLITE METEOROLOGY, VOLUME 4 Interim Report

Verner E. Suomi and Delbert D. Smith Aug. 1972 206 p refs
(Grant NGL-50-002-114)
(NASA-CR-130000) Avail: NTIS HC \$12.50

Summaries, covering southern corn leaf blight, severe thunderstorms and tornadoes, and management of satellite data, are presented. For individual titles, see N73-15643 through N73-15645.

N73-16159# General Motors Corp., Goleta, Calif. Delco Electronics Div.

REMOTE AUTOMATIC MULTIPURPOSE STATION

Walter P. Brown and B. M. Buck Oct. 1972 5 p refs
(Contract N00014-71-C-0357; ARPA Order 1783; NR Proj. 307-340)
(AD-751039; TR-5) Avail: NTIS CSCL 09/6

The report describes monitoring of the remote automatic multipurpose stations which were established to provide remote sensing of oceanographic and meteorological data in the Arctic Regions. GRA

N73-16300* Wyoming Univ., Laramie. Dept. of Geology.

ANALYSIS OF ERTS-1 IMAGERY OF WYOMING AND ITS APPLICATION TO EVALUATION OF WYOMING'S NATURAL RESOURCES Progress Report, Jul. - Dec. 1972

Ronald W. Marrs 20 Jan. 1973 23 p refs
(Contract NAS5-21799)
(E73-10037; NASA-CR-129997; ERTS-1-II-72A) Avail: NTIS HC \$3.25 CSCL 08F

The author has identified the following significant results. Significant results of the Wyoming investigation during the first six months include: (1) successful segregation of Precambrian metasedimentary/metavolcanic rocks from igneous rocks; (2) discovery of iron formation within the metasedimentary sequence; (3) mapping of previously unreported tectonic elements of major significance; (4) successful mapping of large scale fractures of the Wind River Mountains; (5) successful distinction of some metamorphic, igneous, and sedimentary lithologies by color-additive viewing of ERTS images; (6) mapping and interpretation of glacial features in western Wyoming; and (7) development of techniques for mapping small urban areas.

N73-16307* Hunting Surveys, Ltd., Boreham Wood (England). **THE WORLD SURVEYED IN EIGHTEEN DAYS**

Peter G. Mott, Principal Investigator [1973] 3 p Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198
(E73-10044; NASA-CR-130323) Avail: NTIS HC \$3.00 CSCL 08F

There are no author-identified significant results in this report. Earth Resources Technology Satellite 1 was launched on July 23, 1972, on a polar orbit at an altitude of approximately 900 kilometers. The satellite circles the earth fourteen times a day, and its multispectral scanners produce complete coverage of the world every 18 days. The scanning system of the satellite is designed to provide simultaneous images of the earth's surface, each in a different spectral band-green, orange/red, red, and infrared. This data is telemetered to stations on earth where it is processed from its digital form into corrected photographic images. A single photographic exposure covers an area of 185 square kilometers. Results of ERTS-1 have far exceeded all expectations and confirm the belief that the imagery obtained will be of wide-ranging value in the study and mapping of the earth's surface. The knowledge and experience gained from the ERTS-1 data will be applied to a further study based on the much more ambitious Skylab. The improvement in the material recovered from Skylab should mark a leap forward in technical quality and in the corresponding/potential of the imagery. A.L.

N73-16311* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

LATEST RESULTS FROM THE EARTH RESOURCES PROGRAM: SUMMARY OF DISCUSSION SESSION

William Nordberg [1973] 5 p refs
(E73-10049; NASA-TM-X-68939) Avail: NTIS HC \$3.00 CSCL 08B

There are no author-identified significant results in this report. Results are summarized of observations from the first

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Earth Resources Technology Satellite (ERTS-1) and interpretations of these observations in terms of surveying and mapping earth resources over large areas. The summary is based on nine reports presented to the IAF Congress on 14 October 1972.

N73-16333* National Physical Research Lab., Pretoria (South Africa).

TO ASSESS THE VALUE OF SATELLITE IMAGERY IN RESOURCE EVALUATION ON A NATIONAL SCALE

Progress Report, Jul. 1972 - Jan. 1973

O. G. Malan, Principal Investigator Feb. 1973 45 p Sponsored by NASA

(E73-10071; NASA-CR-130012; CSIR-FIS-38) Avail: NTIS HC \$4.25 CSCL 05B

The author has identified the following significant results. ERTS-1 imagery of South Africa, mainly in the form of 1:1,000,000 scale black and white prints of MSS bands, was evaluated for its information content with respect to: (1) soil and terrain mapping; (2) plant ecological mapping; (3) geological mapping; and (4) urban and regional land use mapping at scales below 1:250,000. It was concluded that ERTS-1 imagery can make a significant contribution to accelerate and lower the cost of such surveys. Production of 1:500,000 color composites will remove some of the limitations encountered.

N73-16348* National Aeronautics and Space Administration, Washington, D.C.

INTERNATIONAL WORKSHOP ON EARTH RESOURCES SURVEY SYSTEMS. VOLUME 1

1972 359 p refs Workshop held at Ann Arbor, Mich., 3-14 May 1971; sponsored in part by Dept. of Agr., Dept. of Interior, NOAA, Dept. of Commerce, Naval Oceanog. Office, AID, and Dept. of State

(NASA-SP-283-Vol-1; LC-72-180875) Avail: NTIS MF \$0.95; SOD HC \$6.00 CSCL 14B

The proceedings of a symposium on earth resources survey system are presented. The subjects discussed are: (1) aerospace methods of revealing and evaluating earth resources, (2) remote sensing in geology, hydrology, and geography, (3) applications of remote sensing in agriculture and forestry, (4) remote sensing oceanography, and (5) remote sensing of environmental quality.

N73-16349* National Aeronautics and Space Council, Washington, D.C.

THE EARTH FROM SPACE

William A. Anders In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 1 1972 p 7-9

CSCL 08E

The effectiveness of the Earth Resources Survey Program in obtaining an overall view of the earth's land, water, and air masses is discussed. The plans for the future space programs are described with respect to their impact on the earth resources program. A brief resume of the benefits of the Apollo project to the earth resources program is included. P.N.F.

N73-16350* Geological Survey, Washington, D.C.

A LOFTY VIEW OF THE WORLD AROUND US

W. T. Pecora In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 1 1972 p 11-14

CSCL 08E

Efforts to obtain an improved understanding of earth resources and the limits of the earth's surface are discussed. The efforts are described with respect to: (1) mapping, (2) human needs, (3) minerals, (4) water, (5) food, and (6) planning. The contributions to be made by satellites and remote sensors are reported. P.N.F.

N73-16351* National Aeronautics and Space Administration, Washington, D.C.

THE EARTH RESOURCES SURVEY PROGRAM

Leonard Jaffe In its Intern. Workshop on Earth Resources Surv. Systems, Vol. 1 1972 p 15-32

CSCL 08E

The operation of the Earth Resources Survey Program is discussed. The sensor systems under investigation and being used in the program are described. The specific program objectives are outlined. The roles played by spacecraft, aircraft, and ground observations are reported. Photographs and illustrations are included to amplify the text. P.N.F.

N73-16352* National Aeronautics and Space Administration, Washington, D.C.

INTERNATIONAL ASPECTS OF THE EARTH RESOURCES SURVEY PROGRAM

Arnold W. Frutkin In its Intern. Workshop on Earth Resources Surv. Systems, Vol. 1 1972 p 33-36

CSCL 08E

The international aspects of the Earth Resources Survey Program are presented. The three sources for obtaining earth resources data are defined. The time tables for providing earth resources data are analyzed. The cooperative agreements between foreign nations are reported. The countries which have submitted proposals for the analysis of earth resources data are identified. P.N.F.

N73-16359* National Aeronautics and Space Administration, Washington, D.C.

THE EARTH RESOURCES SURVEY FLIGHT PROGRAMS

Arch B. Park In its Intern. Workshop on Earth Resources Surv. Systems, Vol. 1 1972 p 133-137

CSCL 14B

The NASA program for Earth Resources Survey is discussed. The three space flight experiments involving ERTS-1, Skylab, and ERTS-2 are described. The payloads of the three systems are explained and their capabilities are detailed. The Earth Resources Aircraft Program is presented to show the types of aircraft involved and the equipment required to accomplish the mission. P.N.F.

N73-16361* Michigan Univ., Ann Arbor. Willow Run Labs.
HOW WILL THE NEW TECHNOLOGY ENHANCE CAPABILITIES TO COLLECT AND ANALYZE EARTH RESOURCE DATA?

Richard R. Legault In NASA, Washington Intern. Workshops on Earth Resources Surv. Systems, Vol. 1 1972 p 155-173

CSCL 05B

Advances in sensor technology which provide information from the ultraviolet to the microwave regions of the spectrum are discussed. The relative advantages of the various sensor systems are analyzed. The subjects discussed are: (1) single-band contrast enhancement, (2) multispectral processing, and (3) aircraft instrumentation. Aerial photographs and line drawings are included to amplify the text. P.N.F.

N73-16362* Organization of American States. Office of Regional Development.

SOME CRITERIA FOR MAKING DECISIONS TO INVEST IN RESOURCE SURVEYS, WITH SPECIAL EMPHASIS ON DEVELOPING COUNTRIES

Kirk P. Rogers In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 1 1972 p 179-182

CSCL 08F

The political, institutional, and economic aspects of incorporating earth resources surveys into developing countries is discussed. Additional consideration is given to the: (1) geographic factors (2) data handling capabilities, and (3) identification of clearly established purpose in conducting surveys. Concepts of Latin American data collection experience are analyzed. P.N.F.

N73-16363* United Nations Development Program.

BENEFIT ANALYSES AND DECISION MODELS

M. Michael Gucovsky In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 1 1973 p 183-184

CSCL 148

Decision models for choosing techniques and procedures to obtain information in the field of natural resources development are discussed. Two types of models: (1) type A for natural resources development and (2) type B for management of existing resources are examined. Factors affecting the efficient application of earth resources data are reported. P.N.F.

N73-16364* Comissao Nacional de Atividades Espaciais, Sao Jose Dos Campos (Brazil).

BRAZILIAN PROGRAM FOR REMOTE SENSING OF EARTH RESOURCES (PROJECT SERE)

Joao Botelho Machado / In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 1 1972 p 189-193 refs

CSCL 08G

A description of the remote sensing of earth resources program being implemented in Brazil is presented. The causes of the complexity of the program are identified. The human resources and material resources assigned to the project are reported. A schematic diagram of the organizational structure is provided. Proposals for future developments are discussed. P.N.F.

N73-16367* Consejo de Recursos Naturales no Renovables, Mexico City.

SOME PRACTICAL RESULTS OF REMOTE SENSING OVER TEST SITE 701, EL ORO-TLALPUJAHUA, MEXICO

Carlos Acosta DelCampo / In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 1 1972 p 203-210 refs

CSCL 08F

A comparison of imagery gathered by several remote sensors over Test Site 701 in Mexico showed the superiority of infrared or false-color film over color, panchromatic, black and white, and infrared black and white photographic emulsions in terms of reliability, economy, and speed for economic geology. The characteristics of radar imagery are discussed and the application to economic geology was found to be helpful. Examples of aerial photography are included to compare effectiveness of various processes. Author

N73-16370* United Nations, New York.

THE ACTIVITIES OF THE UNITED NATIONS IN THE AREA OF SPACE

Humberto Jose Ricciardi / In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 1 1972 p 219-221

CSCL 08F

The interest of the United Nations in space programs designed to assist developing nations in the development of their resources is discussed. Past efforts of the United Nations to provide earth resources information to nations requiring such data are described. The various working groups and their functions are reported. P.N.F.

N73-16371* Department of Energy, Mines and Resources, Ottawa (Ontario).

CANADA'S APPROACH TO REMOTE SENSING

L. W. Morley / In NASA, Washington Intern. Workshop on Earth Resources Surv. Systems, Vol. 1 1972 p 223-234

CSCL 14B

The development of remote sensing in Canada at the federal and provincial levels is discussed. The five point program being followed to insure an adequate program are reported. An organizational chart of the interim planning committee on resource satellites and remote airborne sensing is included. The details of a proposal to NASA for earth resources project cooperation are presented. Author

N73-16382* National Aeronautics and Space Administration, Washington, D.C.

INTERNATIONAL WORKSHOP ON EARTH RESOURCES SURVEY SYSTEMS, VOLUME 2

1971 611 p refs Workshop held at Ann Arbor, Mich., 3-14 May 1971; sponsored in part by Dept. of Agr., Dept. of Interior,

NOAA, Naval Oceanog. Office, Agency for Intern. Develop., and Dept. of State (NASA-TM-X-68912) Avail: NTIS MF \$0.95; SOD HC \$5.25 CSCL 14B

N73-16947* Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

POTENTIAL BENEFITS OF REMOTE SENSING: THEORETICAL FRAMEWORK AND EMPIRICAL ESTIMATE

Ludwig M. Eisgruber [1972] 17 p refs

(Grant NGL-15-005-112)

(NASA-CR-130027; Inform-Note-030872) Avail: NTIS HC \$3.00 CSCL 05C

A theoretical framework is outlined for estimating social returns from research and application of remote sensing. The approximate dollar magnitude is given of a particular application of remote sensing, namely estimates of corn production, soybeans, and wheat. Finally, some comments are made on the limitations of this procedure and on the implications of results. Author

N73-16950* Istituto Universitario Navale, Naples (Italy). Ist. di Meteorologia e Oceanografia.

[SELECTED PAPERS ON OCEANOGRAPHY, METEOROLOGY, GEOPHYSICS, AND ATMOSPHERICS CARRIED OUT BY MEMBERS OF THE INSTITUTE OF METEOROLOGY AND OCEANOGRAPHY IN HONOR OF PROF. GIUSEPPA ALIVERTI]

Jun. 1972 301 p refs Partly in ENGLISH; partly in FRENCH; and partly in ITALIAN

Avail: NTIS HC \$17.25

Selected studies in the field of oceanography, geology, geophysics, vulcanology, navigation, solar physics, and hydrometeorology are described. For individual titles, see N73-16951 through N73-16973. ESRO

N73-17298* Environmental Research Inst. of Michigan, Ann Arbor.

SUMMARY REPORT OF WORK ON TEN TASKS Progress Report, 1 Jul. - 31 Dec. 1972

Fred J. Thomson, Fabian C. Polcyn, L. J. Porcelio, M. L. Bryan, I. J. Settinger, W. A. Matila, R. Nalepka, C. T. Wezemak, Robert Horvath, and Robert K. Vincent, Principal Investigators Jan. 1973 50 p refs

(Contract NAS5-21783)

(E73-10086; NASA-CR-130284; Rept-193301-1-P) Avail: NTIS HC \$4.50 CSCL 05B

N73-17490* Alaska Univ., Fairbanks. Dept. of Geology.

ERTS-A DATA AS A TEACHING AND RESEARCH TOOL IN THE DEPARTMENT OF GEOLOGY Progress Report, Jul. 1972 - Jan. 1973

Donald Grybeck, Principal Investigator 20 Feb. 1973 4 p

(Contract NAS5-21833)

(E73-10284; NASA-CR-130567) Avail: NTIS HC \$3.00 CSCL 08G

N73-17934* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

SIGNIFICANT ACCOMPLISHMENTS IN SCIENCES, 1971

Washington 1972 220 p refs Symp. held at Greenbelt, Md., 10 Nov. 1971 Original contains color illustrations

(NASA-SP-312) Avail: NTIS HC \$3.00 CSCL 14B

Research papers are presented on various applications of remote sensing and satellite observation. The data are discussed from flights of many satellites, including Nimbus satellites, OGO satellites, ITOS, IMP, Mariner space probes, and Apollo spacecraft.

N73-18322* Bundesanstalt fuer Bodenforschung, Hannover (West Germany).

MULTIDISCIPLINARY GEOSCIENTIFIC EXPERIMENTS IN CENTRAL EUROPE Progress Report, Oct. 1972 - Jan. 1973

Dieter Bannert, Principal Investigator Jan. 1973 14 p Sponsored by NASA

(E73-10099; NASA-CR-130527) Avail: NTIS HC \$3.00 CSCL 08G

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N73-18327* # Arizona Univ., Tucson. Dept. of Watershed Management.

USE OF EARTH RESOURCES TECHNOLOGICAL SATELLITE (ERTS) DATA IN A NATURAL RESOURCE INVENTORY

Progress Report, 1 Dec. 1972 - 31 Jan. 1973

Ernest B. Fish, Principal Investigator 15 Feb. 1973 1 p

(Contract NAS5-21820)

(E73-10290; NASA-CR-130573) Avail: NTIS HC \$3.00 CSCL 08F

N73-18332* # North Carolina State Univ., Raleigh. Dept. of Geosciences.

UTILIZATION OF ERTS-A DATA IN GEOLOGICAL EVALUATION, REGIONAL PLANNING, FOREST MANAGEMENT, AND WATER MANAGEMENT IN NORTH CAROLINA

Charles W. Welby, Principal Investigator 28 Feb. 1973 2 p

(Contract NAS5-21732)

(E73-10300; NASA-CR-130558) Avail: NTIS HC \$3.00 CSCL 08G

N73-18339* # Alaska Univ., Fairbanks. Geophysical Inst. COORDINATION AND ESTABLISHMENT OF CENTRALIZED FACILITIES AND SERVICES FOR THE UNIVERSITY OF ALASKA ERTS SURVEY OF THE ALASKAN ENVIRONMENT

Progress Report, Jul. 1972 - Jan. 1973

Albert E. Belon, Principal Investigator and John M. Miller 20 Feb. 1973 27 p

(Contract NAS5-21833)

(E73-10307; NASA-CR-130719) Avail: NTIS HC \$3.50 CSCL 14B

The author has identified the following significant results. Scene 1072-21173 of the Anaktuvuk Pass region of the Brooks Range, Alaska, was studied from the point of view of a resource survey for purposes of land use planning as part of the effort to develop ERTS data processing and interpretation techniques. Other data sources and surface observations were utilized to produce a resource survey of a remote and undeveloped region of Alaska. Three vegetative types are apparent: moist tundra, low brush, and high brush. Watersheds are easily defined on the multispectral imagery. Features related indirectly to economic minerals are discernible from ERTS-1 imagery supported by ground truth data. These include mountains, outwash plains and alluvial deposits, drainage patterns, lineaments and probable bedding planes. This region falls within present land class categories which are not inconsistent with the imperatives of the resources. These land class categories include native village withdrawals, regional deficiency area, national interest study area for possible inclusion in a national system, public interest areas, utility corridor, and state land selection.

N73-18371* # Michigan Univ., Ann Arbor. Infrared and Optics Div.

DESIGN OF A STUDY TO EVALUATE BENEFITS AND COST OF DATA FROM THE FIRST EARTH RESOURCES TECHNOLOGY SATELLITE (ERTS-A) Final Report

G. J. Zissis, K. P. Heiss (Mathematica, Inc.), and R. A. Summers (System Planning Corp.) Jul. 1972 255 p refs Prepared in cooperation with Mathematica, Inc. and System Planning Corp. (Contract USGS-14-08-0001-13221)

(Rept-11215-1-F) Avail: NTIS HC \$14.75

Operational systems for information gathering and analysis based on the technological capability being developed under the ERTS-A experiment by the National Aeronautics and Space Administration will have a wide range of economic, environmental, social, and educational benefits, both in the United States and world-wide. Evaluation of benefits and costs of space-acquired data will provide valuable information needed for evaluating future operational systems and guiding future research and development activities. The recommended methodology uses both case studies of individual applications and broad area analyses of related groups of applications. Analysis and presentation of results is facilitated by the use of matrix presentations relating many of the input and output variables involved in the study. Three case studies are described to illustrate some of the features of the methodol-

ogy developed in the report. These case studies are concerned with land use management, exploration for copper, and nautical charting of doubtful shoals.

Author

N73-18372* # Joint Publications Research Service, Arlington, Va.

ENVIRONMENTAL RESEARCH BY MEANS OF MANNED SPACE STATIONS, PART 1

K. Ya. Kondratyev 24 Jan. 1973 256 p refs Transl. into ENGLISH of the book "Issledovaniya Prirodnoy Sredy s Pilotiruyemykh Orbitalnykh Stantsiy" Leningrad, 1972

(JPRS-58055-1-Pt-1) Avail: NTIS HC \$15.00

A report, containing an analysis of visual observation data gathered by Soviet manned spacecraft, a discussion of problems concerning photography methods and photointerpretation from space, and an analysis of the potential uses of space spectrophotometry methods for studying the earth environment and natural resources, is presented.

N73-18377* # Translation Consultants, Ltd., Arlington, Va. SATELLITES AND THE PROBLEM OF THE EARTH'S NATURAL RESOURCES

K. Ya. Kondratyev Washington NASA 1973 52 p refs Transl. into ENGLISH of the book "Sputniki i Problema Prirodnikh Resursov Zemli" Moscow, Znaniye Press, 1971 p 3-46

(Contract NASw-2038)

(NASA-TT-F-739) Avail: NTIS HC \$3.00 CSCL 08F

One of the most interesting of the problems of modern astronautics, that of the use of artificial earth satellites and spacecraft for meteorological and hydrological research, for prospecting for natural resources on planetary scales, and for making geological, topographic, landscape, and other types of surveys of large areas, is discussed.

Author

N73-18402* # National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

EARTH RESOURCES REQUIREMENTS SKYLAB MISSIONS SL-1/SL-2, SL-3, AND SL-4. APPENDIX B: MISSION REQUIREMENTS

Dec. 1972 227 p

(NASA-TM-X-69137; MSC-1-MRD-001-App-B) Avail: NTIS HC \$13.50 CSCL 22A

Earth resources requirements to be investigated by Skylab missions 1 through 4 are presented tabularly. Areas to be investigated include: (1) agriculture, range, and forestry; (2) geology; (3) continental water resources; (4) ocean investigations; (5) atmospheric investigations; (6) coastal zones, shoals, and bays; (7) remote sensing techniques; and (8) cartography.

A.L.

N73-18989* # Bundesanstalt fuer Bodenforschung, Hanover (West Germany).

DO WE NEED A GENERAL REMOTE SENSING PROGRAM IN THE FEDERAL REPUBLIC? [BRAUCHEN WIR IN DER BUNDESREPUBLIK EIN GESAMTPROGRAMM FERNERKUNDUNG?]

R. Muehlfeld 1972 11 p In GERMAN Presented at the 5th DGLR Ann. Meeting, Berlin, 4-6 Oct. 1972

(DGLR-Paper-72-072). Avail: NTIS HC \$3.00

Methods used for remote sensing and the advantages of a remote sensing earth resources program are surveyed. The possibility of developing such a global program in Germany instead of limited activities supervised by different ministries is discussed. Some ideas are presented on how a global program should be organized and what it should include.

ESRO

N73-19194* # Radio Corp. of America, Camden, N.J. Defense Communications System Div.

DESIGN STUDY REPORT. VOLUME 1: TRANSPORT UNIT

Feb. 1973 370 p

(Contract NAS5-11643)

(NASA-CR-130186) Avail: NTIS HC \$20.50 CSCL 14C

Results are presented of mechanical and thermal analyses of the transport mechanism and its pressurized enclosure, and

electrical and thermal analyses of those circuits within the enclosure. Author

N73-19396* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md. **EARTH RESOURCES TECHNOLOGY SATELLITE-1 SYMPOSIUM PROCEEDINGS, 29 SEPTEMBER 1972** William A. Finch, Jr., comp. Jan. 1973 171 p refs Symp. held at Greenbelt, Md. Original contains color illustrations (NASA-TM-X-66193; X-650-73-10) Avail: NTIS HC \$10.75 CSCL 08E

Papers presented to the symposium on ERTS-1 are reported. The performance of sensors and systems, and applications of ERTS-1 imagery are discussed. F.O.S.

N73-19431* Houston Univ., Tex. Dept. of Civil Engineering. **APPLICATION OF REMOTE SENSING Final Report, period ending 10 Jan. 1973** W. J. Graff, comp. 10 Jan. 1973 152 p refs (Contract NAS9-12646) (NASA-CR-126746) Avail: NTIS HC \$9.75 CSCL 14E

Remote sensing and aerial photographic interpretation are discussed along with the specific imagery techniques used for this research. The method used to select sites, the results of data analyses for the Houston metropolitan area, and the location of dredging sites along the Houston Ship Channel are presented. The work proposed for the second year of the project is described. F.O.S.

N73-20344* Earth Satellite Corp., Berkeley, Calif. **A SCHEME FOR THE UNIFORM MAPPING AND MONITORING OF EARTH RESOURCES AND ENVIRONMENTAL COMPLEXES USING ERTS-1 IMAGERY Progress Report, 1 Jan. - 28 Feb. 1973** Charles E. Poulton, Principal Investigator and Robin I. Welch 20 Mar. 1973 5 p (Contract NAS5-21830) (E73-10360; NASA-CR-131131; PR-3) Avail: NTIS HC \$3.00 CSCL 08B

N73-20365* Alaska Univ., Fairbanks. **ERTS-A DATA AS A TEACHING AND RESEARCH TOOL IN THE DEPARTMENT OF GEOLOGY Bimonthly Progress Report** Donald Grybeck, Principal Investigator 1 Apr. 1973 4 p (Contract NAS5-21833) (E73-10403; NASA-CR-131139; BMPR-2) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. ERTS-1 prints have been used extensively in a geology of Alaska class to give a basic framework of the geology of the state. In addition, they have been intermittently used in such diverse classes as: (1) Economic Geology (e.g. the Sn-bearing granites of the Seward Peninsula are particularly noticeable due to their wide contact metamorphic aureoles.) (2) A canned geology of Alaska lecture which has been given to two different introductory geology courses. (3) Structural Geology (e.g. the Fairweather and Denali faults are striking obvious). It was found most convenient for larger classes to prepare 35mm-slides of the ERTS-1 prints that are used in conjunction with slides of the topographic and geologic maps at about the same scale. Thus the emphasis has been in integration of the ERTS-1 material into existing courses. As such, the ERTS-1 data has provided a unique and striking viewpoint that never fails to initiate favorable comment. In addition, prints have been examined by numerous researchers to develop a regional, integrated overview of such varied topics as regional geology to a background for local geologic mapping to studies of ore deposits and to the definition of a formation to be studied in detail at its type locality.

N73-20386* Wyoming Univ., Laramie. Remote Sensing Lab. **ANALYSIS OF ERTS-1 IMAGERY OF WYOMING AND ITS**

APPLICATION TO EVALUATION OF WYOMING'S NATURAL RESOURCES Bimonthly Report, Jan. - Feb. 1973 Ronald W. Marrs and Roy M. Breckenridge 26 Mar. 1973 10 p refs (Contract NAS5-21799) (E73-10425; NASA-CR-131215; ERTS-1-1-73A; BMR-3) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. The Wyoming investigation has progressed according to schedule during the Jan. - Feb., 1973 report period. A map of the maximum extent of Pleistocene glaciation was compiled for northwest Wyoming from interpretations of glacial features seen on ERTS-1 imagery. Using isodensitometry as a tool for image enhancement, techniques were developed which allowed accurate delineation of small urban areas and provided distinction of broad classifications within these small urban centers.

N73-20394* Catholic Univ. of America, Washington, D.C. Research Inst. for Social and Behavioral Sciences. **[ANALYSIS OF ERTS IMAGERY OF AREA NORTH OF SEGOU, REPUBLIC OF MALI] Preliminary Report** Norman H. MacLeod, Principal Investigator [1973] 4 p ref (Contract NAS5-21889) (E73-10434; NASA-CR-131224) Avail: NTIS HC \$3.00 CSCL 08F

N73-20398* American Univ., Washington, D.C. Dept. of Biology. **[ANALYSIS OF ERTS IMAGERY OF OFFICE DU NIGER, REPUBLIC OF MALI] Preliminary Report** Norman H. MacLeod, Principal Investigator Feb. 1973 2 p (Contract NAS5-21892) (E73-10435; NASA-CR-131225; Rept-2) Avail: NTIS HC \$3.00 CSCL 08F

N73-20397* Ohio Dept. of Economic and Community Development, Columbus. **RELEVANCE OF ERTS TO THE STATE OF OHIO Progress Report, Jan. - Mar. 1973** David C. Sweet, Principal Investigator Mar. 1973 17 p Prepared for Battelle Columbus Labs. Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 (Contracts NAS5-21782; BCL-72-17/G-1793) (E73-10437; NASA-CR-131231) Avail: NTIS HC \$3.00 CSCL 08F

N73-20402* Arizona Univ., Tucson. Dept. of Watershed Management. **USE OF EARTH RESOURCES TECHNOLOGICAL SATELLITE (ERTS) DATA IN A NATURAL RESOURCE INVENTORY Progress Report, 1 Oct. 1972 - 31 Mar. 1973** Ernest B. Fish, Principal Investigator 2 Apr. 1973 3 p (Contract NAS5-21820) (E73-10442; NASA-CR-131236) Avail: NTIS HC \$3.00 CSCL 08F

N73-20417* Alaska Univ., Fairbanks. **COORDINATION AND ESTABLISHMENT OF CENTRALIZED FACILITIES AND SERVICES FOR THE UNIVERSITY OF ALASKA ERTS SURVEY OF THE ALASKAN ENVIRONMENT Bimonthly Progress Report** Albert E. Belon, Principal Investigator 31 Mar. 1973 8 p (Contract NAS5-21833) (E73-10459; NASA-CR-131259; BMPR-4) Avail: NTIS HC \$3.00 CSCL 14B

N73-20436* General Electric Co., Philadelphia, Pa. Missiles and Space Div. **ERTS-1 FLIGHT EVALUATION Quarterly Report, 23 Jul. - 23 Oct. 1972** 28 Nov. 1972 232 p refs (Contract NAS5-21808) (NASA-CR-130178; DOC-72SD4262) Avail: NTIS HC \$13.75 CSCL 22C

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Analyses are presented for the flight performance of ERTS-1 during the orbits 0 to 1300. Author

N73-21318*# Direccion de Cartografia Nacional, Caracas (Venezuela).

DEVELOPMENT OF TECHNIQUES FOR THE SIMPLIFICATION OF THE INVESTIGATION AND ESTIMATES PROCESS FOR NATURAL RESOURCES IN REMOTE AND RELATIVELY UNEXPLORED AREAS (VENEZUELA) Report for Jun. 1972 - Mar. 1973

Adolfo C. Romero, Principal Investigator Mar. 1973 8 p
Sponsored by NASA ERTS
(E73-10481; NASA-CR-131301) Avail: NTIS HC \$3.00 CSCL 08F

N73-21320*# Environmental Research Inst. of Michigan, Ann Arbor.

USE OF ERTS DATA FOR A MULTIDISCIPLINARY ANALYSIS OF MICHIGAN RESOURCES Progress Report, 1 Feb. - 21 Mar. 1973

Axel L. Anderson, Principal Investigator 3 Apr. 1973 11 p ref ERTS
(Contract NAS5-21834)
(E73-10483; NASA-CR-131303) Avail: NTIS HC \$3.00 CSCL 08F

N73-21347*# California Univ., Berkeley. Space Sciences Lab. **AN INTEGRATED STUDY OF EARTH RESOURCES IN THE STATE OF CALIFORNIA USING REMOTE SENSING TECHNIQUES** Progress Report

Robert N. Colwell 1 Feb. 1971 195 p refs Original contains color illustrations
(Grant NGL-05-003-404)
(NASA-CR-131392) Avail: NTIS HC \$11.75 CSCL 08F

Remote sensing techniques are proposed for the management of water resources and land use in California. The impact of the California Water Project is emphasized.

N73-21348* California Univ., Berkeley.

INTRODUCTION

Robert N. Colwell *In its* An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Tech. 1 Feb. 1971 8 p
CSCL 08F

Management of earth resources requires accurate knowledge of inventories. Developments of improved remote sensing devices and vehicles for their transport, and automatic data processing equipment and techniques are important management tools for an integrated earth resources survey in California. G.G.

N73-21349* California Univ., Berkeley. Social Sciences Group. **DEFINITION OF EARTH RESOURCE POLICY AND MANAGEMENT PROBLEMS IN CALIFORNIA**

C. West Churchman and Ibrahim Clark *In its* An Integrated Study of Earth Resources in the State of Calif. Using Remote Sensing Tech. 1 Feb. 1971 10 p

CSCL 05A

Management planning for the California water survey considers the use of satellite and airplane remote sensing information on water-source, -center, and -sink geographies. A model is developed for estimating the social benefit of water resource information and to identify the most important types of resource information relevant to regulatory agencies and the private sector. G.G.

N73-21360*# Arizona Univ., Tucson. Office of Arid Land Studies. **RESEARCH FOR APPLICATIONS OF REMOTE SENSING TO STATE AND LOCAL GOVERNMENTS (ARSIG)** Annual Report

Kenneth E. Foster and Jack D. Johnson Feb. 1973 199 p refs
(Grant NGL-03-002-313)

(NASA-CR-131643; OALS-Bull-5) Avail: NTIS HC \$12.00 CSCL 08E

Remote sensing and its application to problems confronted by local and state planners are reported. The added dimension of remote sensing as a data gathering tool has been explored identifying pertinent land use factors associated with urban growth such as soil associations, soil capability, vegetation distribution, and flood prone areas. Remote sensing within rural agricultural setting has also been utilized to determine irrigation runoff volumes, cropping patterns, and land use. A variety of data sources including U-2 70 mm multispectral black and white photography, RB-57 9-inch color IR, HyAC panoramic color IR and ERTS-1 imagery have been used over selected areas of Arizona including Tucson, Arizona (NASA Test Site #30) and the Sulphur Springs Valley. Author

N73-21888* Helsinki Univ. (Finland). Radio Lab.

SPACE ACTIVITIES IN FINLAND IN 1972

Martti Tiuti, ed. and Seppo Urpo, ed. 1973 11 p refs (S-52) Avail: NTIS HC \$3.00

The Organization for Space Activities in Finland is briefly described and aspects of its work discussed. These include: ionospheric and magnetospheric research, lunar and meteorite research, satellite geodesy, satellite orbits, remote sensing, applications of space-based technology, satellite tracking, telemetry and acquisition facilities, international cooperation, and publications. ESRO

N73-22284*# Alabama Univ., University.

INVESTIGATIONS USING DATA IN ALABAMA Bimonthly Progress Report, 7 Dec. 1972 - 9 Feb. 1973

Harold R. Henry, Principal Investigator 9 Feb. 1973 31 p ERTS
(Contract NAS5-21876)
(E73-10509; NASA-CR-131489; BMPR-2) Avail: NTIS HC \$3.75 CSCL 08F

N73-22304*# Geological Survey, Washington, D.C.

ANALYSIS STUDY OF MULTISPECTRAL DATA, ERTS-A, FROM AN AREA IN WEST PAKISTAN Ph.D. Thesis
Robert G. Schmidt, Principal Investigator 1 May 1973 2 p ERTS

(NASA Order S-70243-AG)

(E73-10540; NASA-CR-131616) Avail: NTIS HC \$3.00 CSCL 08F

N73-22345*# California Univ., Berkeley.

AN INTEGRATED STUDY OF EARTH RESOURCES IN THE STATE OF CALIFORNIA USING REMOTE SENSING TECHNIQUES Semiannual Progress Report

Robert N. Colwell 31 Dec. 1972 411 p refs Original contains color illustrations
(Grant NGL-05-003-404)
Avail: NTIS HC \$22.75 CSCL 08B

The earth resources study for California is reported. The objectives, user needs, water management, data acquisition, data processing, and atmospheric effects in image transfer are discussed. F.O.S.

N73-22349* National Environmental Satellite Service, Washington, D.C.

PUBLICATIONS AND FINAL REPORTS ON CONTRACTS AND GRANTS, 1972 - NESS

Apr. 1973 15 p refs
(NOAA-TM; NESS-48) Avail: NTIS HC \$3.00

A listing is provided of articles and reports published by or for the National Environmental Satellite Service. Author

N73-22783*# McDonnell-Douglas Corp., Huntington Beach, Calif.

EARTH ORBITAL EXPERIMENT PROGRAM AND REQUIREMENTS STUDY, VOLUME 6: EARTH OBSERVATIONS (APPENDICES A, B, C)

[1971] 380 p refs
(Contract NAS1-9464)
(NASA-CR-112330) Avail: NTIS HC \$21.00 CSCL 22A

A reference manual for planners of manned earth-orbital research activity is presented. The manual serves as a systems approach to experiment and mission planning based on an integrated consideration of candidate research programs and the appropriate vehicle, mission, and technology development requirements. Long range goals and objectives for NASA activities during the 1970 to 1980 time period are analyzed. The useful and proper roles of manned and automated spacecraft for implementing NASA experiments are described. An integrated consideration of NASA long range goals and objectives, the system and mission requirements, and the alternative implementation plans are developed. Specific areas of investigation are: (1) manned space flight requirements, (2) space biology, (3) spaceborne astronomy, (4) space communications and navigation, (5) earth observation, (6) supporting technology development requirements, (7) data management system matrices, (8) instrumentation matrices, and (9) biotechnology laboratory experiments. Author

N73-22812* Radiation, Inc., Melbourne, Fla. Systems Engineering Dept.
DCS: A GLOBAL SATELLITE ENVIRONMENTAL DATA COLLECTION SYSTEM STUDY Final Report
 Jan. 1973 214 p
 (Contract NAS5-21622)
 (NASA-CR-130232) Avail: NTIS HC \$2.75 CSCL 22A

Cost analysis and technical feasibility data are presented on five medium orbiting and six geosynchronous satellite data collection systems with varying degrees of spacecraft and local user terminal complexity. Data are also provided on system approaches, user requirements, and user classes. Systems considered include orbiting ERTS and EOS type satellites and geosynchronous SmS and SEOS type data collectors. E.H.W.

N73-22817* General Electric Co., Philadelphia, Pa. Missile and Space Div.
ERTS 1 LAUNCH AND FLIGHT ACTIVATION EVALUATION REPORT, 23 - 26 JULY 1972. LAUNCH THROUGH ORBIT 35 AND ORBIT ADJUST OPERATION
 18 Oct. 1972 272 p
 (Contract NAS5-11320)
 (NASA-CR-130150; Doc-72SD4255) Avail: NTIS HC \$15.75 CSCL 22C

The results of the analysis conducted on the telemetry data from the prelaunch, launch, and flight activation phases of the ERTS-1 spacecraft are presented. It is presented by subsystem sections and provides for inter-relationships as they exist between the several subsystems. A brief statement of subsystem characteristics precedes flight evaluation statements. The appendix contains a total list of components flow on ERTS-1 and a complete listing of commands and telemetry functions for reference.

Author

N73-22818* General Electric Co., Philadelphia, Pa. Missile and Space Div.
ERTS 1 FLIGHT EVALUATION REPORT, 23 OCTOBER 1972 - 23 JANUARY 1973
 27 Feb. 1973 192 p refs
 (Contract NAS5-21808)
 (NASA-CR-130207; Doc-73SD4224; Rept-3) Avail: NTIS HC \$11.75 CSCL 22C

Analyses of ERTS-1 performance for the second three months of operation, orbits 1300 to 2600, are presented. Author

N73-23407 Wyoming Univ., Laramie. Remote Sensing Lab.
THE APPLICATION OF REMOTE SENSING DATA APPLIED TO PLANNING IN WYOMING: A DEMONSTRATION PROJECT
 10 Jan. 1973 46 p Sponsored by HUD
 Avail: Issuing Activity CSCL 05B

An evaluation was made of the use of remote sensing applied to designated land planning tasks in the Power River Basin of Wyoming. Data used for interpretation was obtained through the Earth Resources Technology Satellite Program. Areas covered included: (1) water impoundments and lakes; (2) unstable areas;

(3) irrigated versus developed flood plains; (4) coniferous and deciduous tree discrimination; (5) range types and quality; (6) soil types; (7) urban and rural land development; (8) slope estimation; (9) mined areas; (10) mineral resources; (11) construction materials; (12) Gillette urban development; and (13) urban mapping of Casper. A.L.

N73-23417* Earth Satellite Corp., Berkeley, Calif.
PLAN FOR THE UNIFORM MAPPING OF EARTH RESOURCES AND ENVIRONMENTAL COMPLEXES FROM SKYLAB IMAGERY Monthly Progress Report, 2 Jan. - 28 Feb. 1973
 Charles E. Poulton, Principal Investigator 28 Feb. 1973 3 p EREP
 (Contract NAS9-13286)
 (E73-10532; NASA-CR-131597) Avail: NTIS HC \$3.00 CSCL 08B

N73-23425* Wyoming Univ., Laramie. Remote Sensing Lab.
MULTIDISCIPLINARY STUDY OF WYOMING TEST SITES Monthly Progress Report
 R. M. Breckenridge and R. W. Marrs May 1973 6 p EREP
 (Contract NAS9-13298)
 (E73-10552; NASA-CR-131851; EREP-1-73A) Avail: NTIS HC \$3.00 CSCL 08F

N73-23426* Wyoming Univ., Laramie. Remote Sensing Lab.
ANALYSIS OF ERTS-1 IMAGERY OF WYOMING AND ITS APPLICATION TO EVALUATION OF WYOMING'S NATURAL RESOURCES Progress Report, Mar. - Apr. 1973
 Ronald W. Marrs and Roy M. Breckenridge 15 May 1973 11 p refs ERTS
 (Contract NAS5-21799)
 (E73-10554; NASA-CR-131853) Avail: NTIS HC \$3.00 CSCL 08F

N73-23434* Earth Satellite Corp., Washington, D.C.
PLAN FOR THE UNIFORM MAPPING OF EARTH RESOURCES AND ENVIRONMENTAL COMPLEXES FROM SKYLAB IMAGERY Monthly Progress Report, 1-30 Apr. 1973
 Charles E. Poulton, Principal Investigator 30 May 1973 9 p ref EREP
 (Contract NAS9-13286)
 (E73-10562; NASA-CR-131861) Avail: NTIS HC \$3.00 CSCL 08B

N73-23484* Societe d'Etudes Techniques et d'Entreprises Generales, Leplessis-Robinson (France).
EARTH RESOURCES AIRCRAFT FACILITY. VOLUME 1: PROJECT SUMMARY Final Report [EARTH RESOURCES AIRCRAFT FACILITY. VOLUME 1: SOMMAIRE DE L'ETUDE RAPPORT FINAL]
 [1972] 87 p refs In FRENCH 8 Vol.
 (Contract ESTEC-1517/EL)
 (ESRO-CR(P)-117) Avail: NTIS HC \$6.50

Results of a study on the mission planning for a European earth resources survey aircraft are summarized. They include choice of mission, analysis of payload, choice of aircraft, technical feasibility, initial operational program, and juridical aspects of the Earth Resources Aircraft Facility project. ESRO

N73-24382* State of Ohio Dept. of Development, Columbus.
RELEVANCE OF ERTS TO THE STATE OF OHIO Progress Report, Apr. - May 1973
 David C. Sweet, Principal Investigator May 1973 20 p Prepared for Battelle Columbus Labs., Ohio Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
 (Contracts NAS5-21782; BCL-72-27/G-1793)
 (E73-10621; NASA-CR-132032) Avail: NTIS HC \$3.00 CSCL 08F

N73-24394* Alaska Univ., Fairbanks.
ERTS-A DATA AS A TEACHING AND RESEARCH TOOL

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IN THE DEPARTMENT OF GEOLOGY Bimonthly Progress Report

Donald Grybeck, Principal Investigator 7 Jun. 1973 2 p ERTS (Contract NAS5-21833)
(E73-10635; NASA-CR-132094; BMPR-5) Avail: NTIS HC \$3.00 CSCL 08G

The author has identified the following significant results. The ERTS-1 materials continue to be used in a number of courses including Geology of Alaska, Economic Geology, and Structural Geology. In addition, specific talks about the ERTS-1 material were given at a seminar at the Geophysical Institute, to the Geology Department, to numerous individuals, and were extensively used in a popularized talk on the Geology of Alaska to the local Historical Society.

N73-24395* Alaska Univ., Fairbanks.

COORDINATION AND ESTABLISHMENT OF CENTRALIZED FACILITIES AND SERVICES FOR THE UNIVERSITY OF ALASKA ERTS SURVEY OF THE ALASKAN ENVIRONMENT Bimonthly Progress Report

Albert E. Belon, Principal Investigator 30 May 1973 6 p ERTS (Contract NAS5-21833)
(E73-10636; NASA-CR-132095; BMPR-5) Avail: NTIS HC \$3.00 CSCL 14B

N73-25361* Arizona Univ., Tucson. Dept. of Watershed Management.

USE OF EARTH RESOURCES TECHNOLOGICAL SATELLITE (ERTS) DATA IN A NATURAL RESOURCE INVENTORY Progress Report, 1 Apr. - 31 May 1973

Ernest B. Fish, Principal Investigator 31 May 1973 2 p ERTS (Contract NAS5-21820)
(E73-10666; NASA-CR-132177) Avail: NTIS HC \$3.00 CSCL 05B

N73-25382* North Carolina State Univ., Raleigh.

UTILIZATION OF ERTS-1 DATA IN NORTH CAROLINA Interim Report, Dec. 1972 - May 1973

C. W. Welby, Principal Investigator, J. O. Lammi, and R. J. Carson, III Jun. 1973 33 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21732)
(E73-10688; NASA-CR-132199) Avail: NTIS HC \$3.75 CSCL 08B

The author has identified the following significant results. A wide range of potential uses for ERTS-1 imagery is described. Special emphasis has been placed upon studies in the Coastal Plain of North Carolina. Soil groups, water quality, and suspended sediment patterns in estuaries and offshore have been studied. A phytoplankton bloom has possibly been detected. The usefulness of the imagery in coastal landform surveys has been demonstrated as has its usefulness in monitoring developmental activity in the forests. Planners appear hesitant to use the imagery because of its small scale, but it is felt that as they become familiar with the imagery they will find it useful and time-saving for many purposes.

N73-26388* Wyoming Univ., Laramie. Dept. of Geology. MULTIDISCIPLINARY STUDY OF WYOMING TEST SITES Monthly Progress Report

Ronald W. Marrs Jun. 1973 6 p refs EREP (Contract NAS9-13298)

(E73-10697; NASA-CR-133001) Avail: NTIS HC \$3.00

The author has identified the following significant results. A field photometer system has been developed which allows faster and easier measurement of object reflectances. Preliminary tests indicate that the new system will be slightly accurate than the previous filter wheel system, in addition to being easier to operate, more rugged, more compact, and less expensive.

N73-26420* Oregon State Univ., Corvallis. Environmental Remote Sensing Applications Lab.

FIRST YEAR PROJECTS AND ACTIVITIES OF THE ENVIRONMENTAL REMOTE SENSING APPLICATIONS LABORATORY (ERSAL) Annual Progress Report, 1 Apr. 1972 - 31 Mar. 1973

Charles E. Poulton and David P. Faulkner 31 Mar. 1973 59 p refs (Grant NGL-38-002-053)

(NASA-CR-133034) Avail: NTIS HC \$5.00 CSCL 08B

Activities, pilot projects, and research that will effectively close the gap between state-of-the-art remote sensing technology and the potential users and beneficiaries of this technological and scientific progress are discussed in light of the first year of activity. A broad spectrum of resource and man-environment problems are described in terms of the central thrust of the first-year program to support land use planning decisions with information derived from the interpretation of NASA highlight and satellite imagery. Author

N73-26446* Agency for International Development, Washington, D.C. Office of Science and Technology.

REMOTE SENSING: A DEVELOPMENTAL FRAMEWORK AND CASE STUDIES

Glenn E. Schweitzer Jan. 1973 58 p Presented at CENOT Sem. on the Appl. of Remote Sensing in the Determination of Natural Resources, Ankara, Turkey, 10 Nov. 1971

(PB-214861/7; TA/OST-73-15) Avail: NTIS HC \$3.00 CSCL 08B

Assistance is provided for developing country planners and technical specialists in assessing how their countries might participate more effectively in remote sensing activities being supported by the United States and other developed countries. Discussed are: how multispectral techniques can be used by countries with limited investment, trained manpower, and institutional capabilities; and specific activities in three countries which are attempting to apply these advanced techniques to development problems in a very practical way. Author (GRA)

N73-26035* Elliott-Automation Space and Advanced Military Systems, Ltd., Camberley (England).

A STUDY TO DEFINE AN EXPERIMENTAL AIRCRAFT FOR EARTH RESOURCE SURVEYS. VOLUME 1: SUMMARY Final Report

Jul. 1972 97 p Prepared jointly with Fairey Surveys

(Contract ESTEC-1516/71-EL)

(ESRO-CR(P)-128) Avail: NTIS HC \$7.00

The results of a study of a proposed Earth Resources Aircraft Facility (ERAF) to develop a European capability in the remote sensing of earth resources are presented. The objectives are first discussed followed by a description of missions and sensors. The reasons leading to the selection of the Fokker F-27 are given together with a description of the aircraft. The support facilities are noted and ownership and organization discussed. The program for aircraft procurement, conversion and testing is outlined along with the program of operations. Finally, costs and potential problem areas are defined. ESRO

N73-26316* Michigan State Univ., East Lansing.

USE OF ERTS DATA FOR A MULTIDISCIPLINARY ANALYSIS OF MICHIGAN RESOURCES Progress Report Axel L. Anderson, Principal Investigator 28 Jun. 1973 14 p (Contract NAS5-21834)

(E73-10703; NASA-CR-133016; PR-4) Avail: NTIS HC \$3.00 CSCL 08F

The author has identified the following significant results. A computerized procedure has been developed to correlate coordinates from topographic maps and/or aerial photographs with ERTS data coordinates. Application to data from other multispectral scanners is anticipated. In the procedure, a map transformation from earth coordinates to ERTS point and line numbers is calculated using selected ground control points and the method of least squares. The map transformation is then applied to the earth coordinates of selected areas to obtain the

corresponding ERTS point and line numbers. An optional provision allows moving the boundaries of the plots inwards by variable distances (typically half a resolution element) so the selected pixels will not overlap adjacent features.

N73-26323*# Maryland Dept. of State Planning, Baltimore. **INVESTIGATION OF APPLICATION OF ERTS-A DATA TO INTEGRATED STATE PLANNING** Interim Report, Oct. 1972 - Mar. 1973

Edwin Thomas, David S. Simonett, Principal Investigators, John Antenucci, John Garber, William G. Brooner, Wayne G. Rohde, and Dennis Woodward Apr. 1973 49 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21779)

(E73-10716; NASA-CR-133216) Avail: NTIS HC \$4.50 CSCL 08B

N73-26338*# Maryland Dept. of State Planning, Baltimore. **INVESTIGATION OF APPLICATION OF ERTS-A DATA TO INTEGRATED STATE PLANNING IN MARYLAND** Progress Report, period ending 31 May 1973

Edwin L. Thomas, Principal Investigator 31 May 1973 9 p ERTS

(Contract NAS5-21779)

(E73-10732; NASA-CR-133076; PR-4) Avail: NTIS HC \$3.00 CSCL 08B

N73-26350*# National Research Council, Bangkok (Thailand). **THAILAND NATIONAL PROGRAMME OF THE EARTH RESOURCES TECHNOLOGY SATELLITE** Progress Report, Nov. 1972 - Jan. 1973

Pradisth Cheosakul, Principal Investigator Apr. 1973 28 p Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(E73-10746; NASA-CR-133114) Avail: NTIS HC \$3.50 CSCL 08F

The author has identified the following significant results. ERTS-1 data has been used to delineate floating rice regions with a clear distinction between irrigated and nonirrigated areas and recognition of orchard and horticultural crops. Alluvial fans marking the ancient river outlets in the northwestern portion of the Central Plain of Thailand and the shape and size of the flood plains in the central region have been identified and outlined. A new forestry map was constructed using band 5 and band 7 imagery combined with ground observations. A geologic map of Thailand has been constructed from ERTS imagery.

N73-26356*# Kansas Univ., Lawrence. **Space Technology Center.**

[SKYLAB SITES IN KANSAS AND TEXAS] Monthly Progress Report

Joe R. Eagleman, Principal Investigator 18 Jun. 1973 1 p EREP

(Contract NAS9-13273)

(E73-10752; NASA-CR-133120) Avail: NTIS HC \$3.00 CSCL 14B

N73-26356*# Geological Survey Dept., Lobatse (Botswana). **TO ASSESS THE VALUE OF SATELLITE PHOTOGRAPHS IN RESOURCE EVALUATION ON A NATIONAL SCALE** Progress Report, Jan. - May 1973

J. V. Hepworth, Principal Investigator and S. M. Akehurst May 1973 20 p refs Sponsored by NASA ERTS

(E73-10753; NASA-CR-133121) Avail: NTIS HC \$3.00 CSCL 05B

The author has identified the following significant results. Small scale ERTS-1 imagery has enabled investigators to study large areas at a time. The imagery appears to confirm a new theory that Archean greenstone belts in NE Botswana and SW

Rhodesia are co-extensive and that these so-called schist relics formerly covered a much wider area than is apparent now. The central parts of the region bounded by the schist relics are believed to have suffered granitization. A remnant of an older drainage system to the southwest of the Okavango Swamps, which seems to have been newly discovered on the imagery, may be an indication of the seismic instability of the region. Even quite small earth movements in the swamps could radically affect the direction of water flow. The imagery has proved successful in showing areas infested by the water weed *Salvinia Auriculata* in the Chobe and Zambesi rivers. This will be immensely valuable in later surveys on the ground. If the satellite was to have continued working, the imagery would have enabled workers to determine the extent of encroachment of the weed without recourse to field observations.

N73-26357*# North Carolina State Univ., Raleigh. **School of Physical and Mathematical Sciences.**

UTILIZATION OF EREP DATA IN GEOLOGICAL EVALUATION, REGIONAL PLANNING, FOREST MANAGEMENT, AND WATER MANAGEMENT IN NORTH CAROLINA Quarterly Progress Report

Charles W. Welby, Principal Investigator 25 Jun. 1973 1 p EREP

(Contract NAS9-13321)

(E73-10754; NASA-CR-133122) Avail: NTIS HC \$3.00 CSCL 08F

N73-26359*# Environmental Research Inst. of Michigan, Ann Arbor.

[SL-2 PLANS]

Lester V. Manderscheid, Principal Investigator 8 Jun. 1973 1 p EREP

(Contract NAS9-13332)

(E73-10759; NASA-CR-133127) Avail: NTIS HC \$3.00 CSCL 05B

N73-26389*# Scientific Translation Service, Santa Barbara, Calif.

THE EXPLORATION OF THE NATURAL LANDSCAPE WITH THE HELP OF METEOROLOGICAL SATELLITES

Boris S. Vinogradov Washington NASA Jul. 1973 17 p refs Transl. into ENGLISH from Geographische Berichte (East Germany), v. 62, no. 1, 1972 p 1-12

(Contract NASw-2483)

(NASA-TT-F-14965) Avail: NTIS HC \$3.00 CSCL 22C

The applications of satellite TV pictures are discussed. Television pictures from meteorological satellites may be used in oceanology for studying the currents (according to cloud indicators), the motion of the sea (on the basis of the type of reflections caused by the sun) and of the drift ice (according to the color and texture of the picture). In hydrology, aside from the investigation of snow-covered areas, they have essential importance for studying large river valleys, lakes and dam structures. In geology and geomorphology such photographs may be valuable for studying extended tectonic structures and larger relief forms. One of the most promising fields is pedology as well as geobotany, where television pictures are used for improvement and correction of maps in medium to small scale. for studying the dynamics and seasonal rhythm of vegetation as well as for observing big fires and dust storms. Author

N73-26394*# System Planning Corp., Arlington, Va. **EARTH RESOURCES SURVEY APPLICATIONS OF THE SPACE SHUTTLE SORTIE MODE** Final Report

Ravi D. Sharma, William L. Smith, and Fred J. Thomson 11 May 1973 103 p refs

(Contract NASw-2446)

(NASA-CR-132207; Rept-113) Avail: NTIS HC \$7.25 CSCL 22A

The use of the shuttle sortie mode for earth observation applications was investigated and its feasibility for applied research and instrument development was appraised. The results indicate that the shuttle sortie missions offer unique advantages and

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that specific aspects of earth applications are particularly suited to the sortie mode. Author

N73-27251* Ohio Dept. of Economic and Community Development, Columbus.

RELEVANCE OF ERTS-1 TO THE STATE OF OHIO Semian-
nual Progress Report, Jan. - Jun. 1973

David C. Sweet, Terry L. Wells, and George E. Wukelic, Principal Investigators 16 Jul. 1973 50 p refs Prepared for Battelle Columbus Labs. Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contracts NAS5-21782; BCL-72-17/G-1793)

(E73-10775; NASA-CR-133142; SAPR-2) Avail: NTIS HC \$4.50 CSCL 08F

The author has identified the following significant results. During the first six months of project effort the ability of ERTS-1 imagery to be used for mapping and inventorying strip-mined areas in southeastern Ohio was reported as a significant project result. During this reporting period, the potential of using ERTS-1 imagery in water quality and coastal zone management of Lake Erie became apparent and the extent that ERTS-1 imagery could contribute to localized (metropolitan/urban), multicounty, and overall state land use needs was experimentally demonstrated.

N73-27754* Joint Publications Research Service, Arlington, Va.

ORBITAL STATIONS AND THE STUDY OF EARTH FROM SPACE

B. N. Petrov 30 Jul. 1973 25 p refs Transl. into ENGLISH from Upr. Kosmos (Moscow), v. 1, 1972 p 7-22 (JPRS-59650) Avail: NTIS HC \$3.25

A discussion of new prospects for studying from space the earth's resources, the ocean, the upper atmosphere of the earth and meteorological and hydrological processes is presented. Space experiments which have led to the establishment of orbital space stations are discussed. Current efforts to design, launch, and establish space stations are reported. Author

N73-27816* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

SIGNIFICANT ACCOMPLISHMENTS IN TECHNOLOGY, 1972

Washington 1973 186 p refs Symp. held at Greenbelt, Md., 7-8 Nov. 1972

(NASA-SP-326; LC-73-600090) Avail: NTIS HC \$3.00 CSCL

Space applications research and technology centered reported at this conference centered on spacecraft guidance and control, sensor technology, ground operations, and communications and navigation systems.

N73-28206* Tel-Aviv Univ. (Israel). Dept. of Environmental Sciences.

MULTIDISCIPLINARY USES IN ISRAEL Progress Report, 1 Jan. - 30 Jun. 1973

Joseph Otterman, Principal Investigator 2 Jul. 1973 5 p refs Sponsored by NASA ERTS

(E73-10800; NASA-CR-133133) Avail: NTIS HC \$3.00 CSCL 08H

N73-28207* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

SYMPOSIUM ON SIGNIFICANT RESULTS OBTAINED FROM THE EARTH RESOURCES TECHNOLOGY SATELLITE-1. VOLUME 1: TECHNICAL PRESENTATIONS, SECTIONS A AND B

Stanley C. Freden, ed., Enrico P. Mercanti, ed., and Margaret A. Becker, ed. 1973 1686 p refs Symp. held at New Carrollton, Md., 5-9 Mar. 1973 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(E73-10824; NASA-SP-327; LC-73-600115) Avail: NTIS MF \$0.95; SOD HC \$13.65 Domestic Postpaid or \$12.50 GPO Bookstore per set 35 NAS 1.21:327 CSCL 05B

The proceedings of a conference on the significant results obtained by remote sensors mounted in the ERTS-1 satellite are presented. The subjects discussed include the following: (1) agriculture, forestry and range resources, (2) mineral resources, (3) geological structures and landform surveys, (4) environmental surveys, (5) water resources, (6) land use and mapping, (7) development of interpretation techniques, (8) marine resources and ocean surveys, and (9) regional resource surveys. For individual titles, see N73-28208 through N73-28388.

N73-28208* General Electric Co., Philadelphia, Pa.

ERTS-1 DATA PRODUCT PERFORMANCE

B. T. Bachofer In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1-9 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

CSCL 05B

The quality of the ERTS-1 data products produced during the initial months of system operation are evaluated. Quantitative performance data - principally geometric and radiometric accuracy and resolution - are determined for these data products. A comparison of these measurements with prelaunch predictions is also made. Author

N73-28217* Nevada Univ., Reno. Remote Sensing Lab.

ERTS-1 EVALUATION OF NATURAL RESOURCES MANAGEMENT APPLICATIONS IN THE GREAT BASIN

Paul T. Tueller and Garwin Lorain In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 77-85 ERTS.

(Paper-A9) CSCL 01F

The relatively cloud free weather in the Great Basin has allowed the accumulation of several dates of excellent ERTS-1 imagery. Mountains, valleys, playas, stream courses, canyons, alluvial fans, and other landforms are readily delineated on ERTS-1 imagery, particularly with MSS-5. Each band is useful for identifying and studying one or more natural resource features. For example, crested wheatgrass seedlings were most easily identified and measured on MSS-7. Color enhancements simulating CIR were useful for depicting meadow and phreatophytic vegetation along water bodies and stream courses. Work is underway to inventory and monitor wildfire areas by age and successional status. Inventories have been completed on crested wheatgrass seedlings over the entire State of Nevada, and inventories of playa surfaces, water surfaces, phreatophytic vegetation, snow cover, meadows, and other features is continuing. Vegetation ecotones are being delineated for vegetation mapping. The pinyon/juniper-northern desert shrub ecotone has been identified with considerable success. Phenology changes can be used to describe vegetation changes for management. Author

N73-28359* North Carolina State Univ., Raleigh.

MULTIDISCIPLINARY APPLICATION OF ERTS-1 DATA TO NORTH CAROLINA NATURAL RESOURCES MANAGEMENT

Charles W. Welby, J. O. Lammi, and Robert J. Carson In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1443-1450 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-R1) CSCL 08F

Two examples are given of ERTS-1 data: monitoring of man's activities affecting forest resources and pinpointing sources of sediment load in streams and rivers in North Carolina. Author

N73-28360* Oregon State Univ., Corvallis.

NATURAL RESOURCES INVENTORY AND MONITORING IN OREGON WITH ERTS IMAGERY

G. H. Simonson, D. P. Paine, C. E. Poulton, R. D. Lawrence, J. H. Sherzog, and R. J. Murray /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1451-1458 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-R2) CSCL 08F

Multidiscipline team interpretation of ERTS satellite and highlight imagery is providing resource and land use information needed for land use planning in Oregon. A coordinated inventory of geology, soil-landscapes, forest and range vegetation, and land use for Crook County, illustrates the value of this approach for broad area and state planning. Other applications include mapping fault zones, inventory of forest clearcut areas, location of forest insect damage, and monitoring irrigation development. Computer classification is being developed for use in conjunction with visual interpretation. Author

N73-28361* Ohio Dept. of Economic and Community Development, Columbus.

RESOURCE MANAGEMENT IMPLICATIONS OF ERTS-1 DATA TO OHIO

David C. Sweet, Terry L. Wells, and George E. Wukelic (Battelle Columbus Labs., Ohio) /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1459-1466 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-R3) CSCL 08F

Initial experimental analysis of ERTS-1 imagery has demonstrated that remote sensing from space is a means of delineating and inventorying Ohio's strip-mined areas, detecting power plant smoke plumes, and proving the data necessary for periodically compiling land use maps for the entire state. The nature and extent of these problems throughout Ohio, how ERTS data can contribute to their solution, and estimates of the long term significance of these initial findings to overall resource management interests in Ohio are summarized. Author

N73-28363* American Univ., Washington, D.C. Dept. of Biology.

APPLICATIONS OF REMOTE SENSING (ERTS) TO RESOURCE MANAGEMENT AND DEVELOPMENT IN SAHEL- IEN AFRICA (REPUBLIC OF MALI)

N. H. MacLeod /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1475-1481 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-R5) CSCL 08F

The primary resource management problem in Sub-Saharan Africa (the Sahel) is increasing aridity or desertification. Space observations of sand streams, dune orientations, moisture and vegetation changes and other factors associated with desertification have been made. A second major interest is grazing of cattle, sheep and goats which is associated with major movements of people and animals twice yearly to obtain forage. The changes in available forage are being observed. The location of the cultivators is also being mapped from ERTS imagery. Hydrological analysis is being carried on in the Niger and Bani river watersheds. So far, good imagery of the maximum flood stage has been obtained and assessed. Author

N73-28364* Institut Francais du Petrole, Rueil-Malmaison.

FIRST ERTS-1 RESULTS IN SOUTHEASTERN FRANCE: GEOLOGY, SEDIMENTOLOGY, POLLUTION AT SEA

A. Fontanel, J. Guillemot, and M. Guy /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1483-1511

refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Paper-R6) CSCL 08C

Results obtained by four ERTS projects in southeastern France are summarized. With regard to geology, ERTS photos of Western Alps are very useful for tectonic interpretation because large features are clearly visible on these photographs even though they are often hidden by small complicated structures if studied on large scale documents. The 18-day repetition coverage was not obtained, and time-varying sedimentological surveys were impossible. Nevertheless, it was possible to delineate the variations of the shorelines in the Rhone Delta for a period covering the least 8,000 years. Some instances of industries discharging pollutant products at sea were detected, as well as very large anomalies of unknown origin. Some examples of coherent optical processing have been made in order to bring out tectonic features in the Alps mountains. Author

N73-28366* Geological Survey, Washington, D.C.

UNIQUE CHARACTERISTICS OF ERTS

Alden P. Colvocoresses /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1523-1525 ERTS

CSCL 05B

The manned spaceflights have demonstrated what film cameras can do in space and they could provide a data source from which maps would be one of the principal products. ERTS was not defined with mapping as one of its principal objectives, but with ERTS-1 in orbit certain unique characteristics or advantages of the electronic transmission (TV) earth sensing system become apparent to the mapmaker. Six of the more obvious advantages over aircraft and satellite film systems are: (1) long life and coverage; (2) near real time; (3) orthogonality; (4) radiometric fidelity; (5) extension into the near IR wavelengths; and (6) extension into the thermal wavelengths. Author

N73-28387* Imperial Government of Iran, Tehran. Plan Organization.

APPLICATION OF ERTS-1 IMAGERY IN THE FIELDS OF GEOLOGY, AGRICULTURE, FORESTRY, AND HYDROLOGY TO SELECTED TEST SITES IN IRAN

Khosro Ebtehadj /In NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 1, Sect. A and B 1973 p 1699-1714 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

CSCL 08G

The preliminary study of the ERTS-1 imagery coverage of Iran, commenced on October 26, 1972. All of the images were carefully examined, and a photomosaic covering approximately ninety-five per cent of the country was prepared. A number of images of selected areas were studied in detail. In the field of geology, a number of large scale faults were identified, which do not figure on geological maps. Furthermore, a preliminary study was carried out on the recent sediments, their possible sources, and origin. A limited number of geological work maps were prepared as well. In the fields of agriculture and forestry, studies based on color composite prints of certain areas were undertaken, with a purpose of identifying potential arable areas. Investigations in the field of water resources resulted in the discovery of a number of small lakes, and streams. Furthermore, fluctuations of the water level in some lakes were observed. Author

N73-28389* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

SYMPOSIUM ON SIGNIFICANT RESULTS OBTAINED FROM EARTH RESOURCES TECHNOLOGY SATELLITE-1. VOLUME 2: SUMMARY OF RESULTS

Stanley C. Freden, ed., Enrico P. Mercanti, ed., and Donald E.

09 GENERAL

Witten, ed. May 1973 205 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (E73-10825; NASA-TM-X-66283; X-650-73-127) Avail: NTIS HC \$12.25 CSCL 05B

The proceedings of a conference on the significant results obtained from ERTS-1 are presented. The subjects discussed include the following: (1) identification and mapping of soils, vegetation, and water resources in Texas using computer techniques, (2) geologic application of satellite imagery in Alaska, (3) multidisciplinary survey for management of Alaskan resources, and (4) application of satellite imagery to flood inundation mapping.

Author

N73-28390* California State Government, Sacramento.

KEYNOTE ADDRESS

Ed Reinecke /in NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 2 May 1973 p 5-12 ERTS CSCL 05A

The keynote address of the conference on the significant results obtained by ERTS-1 is presented. The application of ERTS-1 imagery to the mapping of the state of California is stressed. Actions taken by the state executive branch in response to ERTS-1 data are discussed. The continued program and funding aspects of data utilization in developing California resources are reported.

Author

N73-28391* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

REVIEW OF ERTS-1 STATUS

William Nordberg /in its Symp. on Significant Results obtained from the ERTS-1, Vol. 2 May 1973 p 13-16 ERTS

CSCL 05B

A review of the ERTS-1 status and a description of the ERTS systems are presented. The manner in which the remote sensors receive information for transmission to ground stations is described. The orbit of the ERTS-1 is analyzed. The characteristics of the data and the processing procedures are reported. Specifications of the equipment aboard the satellite are defined.

Author

N73-28394* Alaska Univ., Fairbanks.

A MULTIDISCIPLINARY SURVEY FOR THE MANAGEMENT OF ALASKAN RESOURCES UTILIZING ERTS IMAGERY John M. Miller and Albert E. Belon /in NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 2 May 1973 p 39-50 An earlier version of this paper was published in Volume 1, pages 999-1006 Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

CSCL 05B

The application of ERTS-1 imagery for a multidisciplinary study of Alaskan resources is discussed. ERTS-1 data form a politically neutral base from which resource surveys can be made without arousing suspicions from groups which have mutually conflicting goals. The specific use of ERTS-1 imagery for monitoring migratory animals, pipeline locations, road construction, snow cover, and vegetation growth is reported. Maps, illustrations, and photographs are provided to support the data.

Author

N73-28400* Corps of Engineers, Washington, D.C.
THE EARTH RESOURCES PROGRAM OF THE CORPS OF ENGINEERS

John W. Jarman /in NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 2 May 1973 p 127-141 Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

CSCL 08B

The mission of the Corps of Engineers of the U.S. Army and the contributions made by the ERTS-1 data system are discussed. The use of satellite-borne sensors and aerial photography for projects involving engineering geology, flood control, master planning, and fluid dynamics and interactions is reported. Examples of engineering projects are provided in the form of aerial photographs and multispectral band scanner imagery.

Author

N73-28401* Geological Survey, Washington, D.C.
APPLICATION OF ERTS-1 RESULTS TO US DEPARTMENT OF INTERIOR PROGRAMS

John M. DeNoyer /in NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 2 May 1973 p 142-145 ERTS

CSCL 08F

The activities of the U.S. Department of Interior which have benefited from ERTS-1 data are described. It is stated that the primary interest is in the area of land use. Legislative actions regarding land use are reported. Programs involving renewable resources are stressed.

Author

N73-28404* Mississippi State Office of Science and Technology, Jackson.

APPLICATION OF ERTS RESULTS TO LAND AND RESOURCE MANAGEMENT IN THE STATE OF MISSISSIPPI

Preston T. Bankston /in NASA. Goddard Space Flight Center Symp. on Significant Results obtained from the ERTS-1, Vol. 2 May 1973 p 167-181 Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

CSCL 08B

The application of ERTS-1 data to land and resource management in the State of Mississippi is discussed. Land use maps using various types of photographic imagery are provided to describe the nature of the engineering projects being conducted. Examples of forest maps and wildlife habitat maps are included. Some of the problems involved in applying the ERTS imagery to specific activities are reported.

Author

N73-28405* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

SYMPOSIUM ON SIGNIFICANT RESULTS OBTAINED FROM EARTH RESOURCES TECHNOLOGY SATELLITE-1. VOLUME 3: DISCIPLINE SUMMARY REPORTS

Stanley C. Freden, ed. and Enrico P. Mercanti, ed. May 1973 122 p refs ERTS (E73-10826; NASA-TM-X-66284; X-650-73-155) Avail: NTIS HC \$8.25 CSCL 05B

Discipline summary reports are presented for significant results obtained from ERTS-1 investigations. Discipline areas covered are: (1) agriculture, forestry, and range resources; (2) land use and mapping; (3) mineral resources, geological structure, and landform surveys; (4) environment surveys; (5) water resources; (6) marine resources and ocean surveys; (7) interpretation techniques development; and (8) multidisciplinary/regional resource surveys.

N73-28413* National Aeronautics and Space Administration, Wallops Station, Wallops Island, Va.

MULTIDISCIPLINARY/REGIONAL RESOURCE SURVEYS

Gilmore H. Trafford /in its Symp. on Significant Results obtained from the ERTS-1, Vol. 3 May 1973 p 95-101 refs ERTS

Avail: NTIS CSCL 08F

The multidisciplinary/regional resource surveys summary is presented in four parts: land use, geologic interpretation, resource survey, and pollution monitoring. Significant results derived from ERTS-1 imagery and data for these four disciplines are briefly reviewed and summarized.

A.L.

N73-28419* Alaska Univ., Fairbanks. Dept. of Geology.
ERTS-1 DATA AS A TEACHING AND RESEARCH TOOL
IN THE DEPARTMENT OF GEOLOGY Semiannual Technical
 Report, Feb. - Jul. 1973

Donald Grybeck, Principal Investigator 31 Jul. 1973 7 p
 ERTS

(Contract NAS5-21833)

(E73-10841; NASA-CR-133403; SATR-2) Avail: NTIS HC
 \$3.00 CSCL 051

The author has identified the following significant results.
 During the sixth bi-monthly period, a mosaic was constructed in
 MSS band 6 of the southeastern one-half of Alaska. A mosaic
 of the whole state awaits additional coverage to fill in some
 gaps. In addition, new material is being monitored as it arrived
 at the Geophysical Institute and from the NASA Indices for
 inclusion into the departmental collections. No geology courses
 are being taught during the summer.

N73-28422* Wyoming Univ., Laramie. Dept. of Geology.
ANALYSIS OF ERTS-1 IMAGERY AND ITS APPLICATION
TO EVALUATION OF WYOMING'S NATURAL RESOURCES
 Progress Report, Jan. - Jun. 1973

Robert S. Houston, Principal Investigator and Ronald W. Marra
 20 Jul. 1973 19 p refs ERTS

(Contract NAS5-21799)

(E73-10844; NASA-CR-133423) Avail: NTIS HC \$3.00 CSCL
 08F

The author has identified the following significant results.
 Significant results of the Wyoming ERTS-1 investigation during
 the first six months (July-December 1972) included: (1) successful
 segregation of Precambrian metasedimentary/metavolcanic rocks
 from igneous rocks, (2) discovery of iron formation within the
 metasedimentary sequence, (3) mapping of previously unreported
 tectonic elements of major significance, (4) successful mapping
 of large scale fracture systems of the Wind River Mountains,
 (5) successful distinction of some metamorphic, igneous, and
 sedimentary lithologies by color additive viewing, (6) mapping
 of large scale glacial features, and (7) development of techniques
 for mapping small urban areas.

N73-28486 Plessey Co., Ltd., Havant (England).

[AIMS AND REQUIREMENTS OF FUTURE MULTISPECTRAL
SCANNING PROGRAMS]

R. A. G. Savigear /n Plessey Radar Res. Centre Multispectral
 Scanning Systems and their Potential Appl. to Earth Resources
 Surveys Apr. 1973 p 193-202 refs

A coordinated approach is discussed to the way in which
 multispectral scanning might most usefully be implemented or
 used. The points considered are: aim of future programs, the
 methodological and technological requirements, the necessity
 for a flexible system, and the necessity for adequately surveyed
 and instrumented test areas. ESRO

N73-29209* National Aeronautics and Space Administration.
 John F. Kennedy Space Center, Cocoa Beach, Fla.
PLANNING APPLICATIONS IN EAST CENTRAL FLORIDA
 Progress Report, 1 Jun. - 31 Jul. 1973

John W. Hannah, Garland L. Thomas, and Fernando Esperza,
 Principal Investigators 31 Jul. 1973 14 p ref Prepared in
 cooperation with Brevard County Planning Dept., Titusville, Fla.
 ERTS

(Contract NAS5-21847)

(E73-10852; NASA-TM-X-69343) Avail: NTIS HC \$3.00 CSCL
 08B

N73-29235* Nevada Univ., Reno. Mackay School of Mines.
[FIELD COLLECTION OF SPECTRAL AND GROUND TRUTH
DATA FOR RB-57 AND SKYLAB OVERFLIGHTS] Progress
 Report, 1-30 Jun. 1973

Jack Quade, Principal Investigator 30 Jun. 1973 2 p EREP
 (Contract NAS9-13274)

(E73-10884; NASA-CR-133520) Avail: NTIS HC \$3.00 CSCL
 05B

N73-29238* Arizona Univ., Tucson. Dept. of Watershed
 Management.

USE OF EARTH RESOURCES TECHNOLOGICAL SATELLITE
(ERTS) DATA IN A NATURAL RESOURCE INVENTORY
 Progress Report, 1 Jun. - 31 Jul. 1973

Ernest B. Fish, Principal Investigator and Phil R. Ogden 9 Aug.
 1973 2 p ERTS

(Contract NAS5-21820)

(E73-10889; NASA-CR-133527) Avail: NTIS HC \$3.00 CSCL
 08F

N73-29248* Environmental Research Inst. of Michigan, Ann
 Arbor. Infrared and Optics Div.

ERIM PROGRESS REPORT ON USE OF ERTS-1 DATA:
SUMMARY REPORT OF WORK ON TEN TASKS Progress
 Report, 1 Jan. - 30 Jun. 1973

F. J. Thomson, Principal Investigator Jul. 1973 141 p refs
 Original contains color imagery. Original photography may be
 purchased from the EROS Data Center, 10th and Dakota Avenue,
 Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21783)

(E73-10899; NASA-CR-133556; Rept-193300-16-P) Avail:
 NTIS HC \$9.25 CSCL 05B

The author has identified the following significant results.
 Several of the tasks have produced significant results which are
 summarized: (1) Absolute water depth can be calculated from a
 ratio of signals from bands MSS 4 and MSS 5. (2) A 13 category
 terrain feature classification map of Yellowstone National Park
 has been produced using supervised pattern recognition techni-
 ques. (3) ERTS-1 data has been shown to provide a detection
 and monitoring capability for a number of water quality problems
 associated with off-shore ocean dumping sites and inland lakes.
 (4) A corrected ratio of bands MSS-5 and MSS-7 signals has
 been formed. (5) A concise format has been devised for storing
 the ratio signatures of geologic rock and mineral materials
 determined from laboratory reflectance spectra. (6) Results of
 work in information extraction demonstrate: signal variability exists
 among ERTS-1 detectors in any one spectral band that will
 impact users doing quantitative analysis on successive ERTS-1
 images; a newly developed computer-aided procedure for
 correlating ERTS-1 pixels to ground features; the strong influence
 of atmospheric effects in ERTS-1 data; and area estimation
 accuracies are better using the ERIM proportion estimation
 algorithm than for conventional recognition techniques.

N73-29253* Alaska Univ., Fairbanks. Geophysical Inst.
COORDINATION AND ESTABLISHMENT OF CENTRALIZED
FACILITIES AND SERVICES OF THE UNIVERSITY OF
ALASKA ERTS SURVEY OF THE ALASKAN ENVIRONMENT
 Semiannual Technical Report, Feb. - Jul. 1973

Albert E. Belon, Principal Investigator and John M. Miller 31 Jul.
 1973 16 p refs ERTS

(Contract NAS5-21833)

(E73-10904; NASA-CR-133561; SATR-2) Avail: NTIS HC
 \$3.00 CSCL 14B

The author has identified the following significant results.
 The objective of this project is to provide a focus for the entire
 University of Alaska ERTS-1 effort (12 projects covering 10
 disciplines and involving 8 research institutes and science
 departments). Activities have been concentrated on the implemen-
 tation of the project's three primary functions: (1) coordination
 and management of the U of A ERTS-1 program, including
 management of the flow of data and data products; (2) acquisition,
 installation, test, operation, and maintenance of centralized
 facilities for processing ERTS-1, aircraft, and ground truth data;
 and (3) development of photographic and digital techniques for
 processing and interpreting ERTS-1 and aircraft data. With minor
 exceptions these three functions are now well-established and
 working smoothly.

N73-29277* Geological Survey Dept., Lobatse (Botswana).
TO ASSESS THE VALUE OF SATELLITE PHOTOGRAPHS
IN THE RESOURCE EVALUATION ON A NATIONAL SCALE
 Progress Report, May - August 1973

J. V. Hepworth, Principal Investigator and S. M. Akehurst 23 Aug.
 1973 10 p refs ERTS

09 GENERAL

(E73-10928; NASA-CR-133585; SMA/7/73) Avail: NTIS HC \$3.00 CSCL 14E

The author has identified the following significant results. Some observations have been made on ERTS-1 color imagery and comparison of imagery. Results of geophysical work are correlated with ERTS-1 imagery and new lineaments are postulated in the northern Kalahari Desert. ERTS-1 imagery reveals complex structural trends in the Basement Complex in the Selebi-Pikwe area.

N73-29278* Geological Survey Dept., Lobatse (Botswana). **TO ASSESS THE VALUE OF SATELLITE PHOTOGRAPHS IN RESOURCE EVALUATION ON A NATIONAL SCALE** Progress Report, Sep. - Dec. 1972

J. V. Hepworth, Principal Investigator and S. M. Akehurst 17 Jan. 1973 21 p refs ERTS

(E73-10929; NASA-CR-133586; SMA/5/73) Avail: NTIS HC \$3.25 CSCL 14E

N73-29279* National Physical Research Lab., Pretoria (South Africa).

TO ASSESS THE VALUE OF SATELLITE IMAGERY IN RESOURCE INVENTORIZATION ON A NATIONAL SCALE Progress Report, Feb. - Jul. 1973

O. G. Malan, Principal Investigator Aug. 1973 53 p refs Sponsored by NASA. Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (E73-10931; NASA-CR-133589; FIS-40) Avail: NTIS HC \$4.75 CSCL 08B

The author has identified the following significant results. Production of 1:500,000 scale false color photolithoprints proved to be very valuable. Significant results were obtained in geomorphological mapping, mapping of disturbed and undisturbed natural vegetation as well as in the discovery of major geologic lineaments, some of which may be associated with mineralization. The cartographic quality of system corrected MSS imagery was also evaluated.

N73-29339* Israel Program for Scientific Translations, Ltd., Jerusalem.

THE TENTH SOVIET ANTARCTIC EXPEDITION, 1965 - 1966. GENERAL DESCRIPTION AND SCIENTIFIC RESULTS

M. E. Ostrekin, ed. and I. G. Petrov, ed. 1971 462 p refs Transl. into ENGLISH from Tr. Sov. Antarkt. Eksped. (USSR), v. 48, 1969 474 p Prepared for NSF

(TT70-50072; IPST-5761) Avail: NTIS HC \$25.25

The findings of the Tenth Soviet Antarctic Expedition are presented. The subjects discussed are: (1) shipboard meteorological research, (2) ice conditions during the summer of 1965, (3) hydrological research, (4) radar studies of ice sheet formations, (5) descriptions of seasonal plankton collections, and (6) physiological reactions of personnel.

N73-29384* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

REMOTE SENSING: THE APPLICATION OF SPACE TECHNOLOGY TO THE SURVEY OF THE EARTH AND ITS ENVIRONMENT

Ronald J. Schertler 1973 13 p Presented at Natl. Conv. of the Natl. Sci. Teachers Assoc., Detroit, Mich., 30 Mar. - 4 Apr. 1973

(NASA-TM-X-68266) Avail: NTIS HC \$3.00 CSCL 08F

Research in the earth sciences and management of both natural and man-made resources has been hindered by the difficulty of obtaining accurate and timely information on regional and global scale. Space surveys with remote sensing instruments are simply another means of attempting to attain the total knowledge of the resources needed for sound planning, development, and conservation. The use of earth orbiting satellites will greatly expand the ability to collect this information. The collection and use of these data and imagery, however, are not an end

in itself, but only the means to an end, that of achieving total resource knowledge. Satellite systems will provide a valuable supplement to existing aerial and ground based observation techniques.

Author

N73-29394* Societe d'Etudes Techniques et d'Entreprises Generales, Lappes-Robinson (France).

EARTH RESOURCES AIRCRAFT FACILITY: ANALYSIS OF THE GEOSCIENTIFIC REQUIREMENTS

D. Carceau, J. Noel, P. Ogier, Y. Vuillaume, and G. Weecksteen Paris ESRO Nov. 1972 150 p refs In FRENCH Prepared jointly with Bur. de Rech. Geol. et Minieres (Contract ESTEC-1517/71)

(ESRO-CR-97) HC \$9.50

A survey was made of the remote sensing requirements in the earth sciences field by consulting European experts in the following disciplines: Geology, hydrology, oceanography, agriculture, forestry, plant ecology, geography and environmental control. Requirements were selected on the basis of feasibility criteria; for example, the fact that remote sensing is at present limited to the observation of surface phenomena. Classification of the requirements at ecogeographical-unit level made it possible to indicate mission objectives that could be incorporated into a coherent experimental program. Both multidisciplinary and specific geographic zones were proposed for this program. They were selected on the basis of their ability to provide material illustrative of the mission objectives chosen, the availability of ground truth evidence and the existence of suitable measuring equipment. Emphasis is laid on the multidisciplinary implications of such an experimental program.

Author

N73-29419* Nevada Univ., Reno. Mackay School of Mines. **[AIRCRAFT AND FIELD SUPPORT REQUIREMENTS FOR SKYLAB 2 MISSION]** Progress Report, 1-31 Jul. 1973

Jack Quade, Principal Investigator 31 Jul. 1973 2 p EREP (Contract NAS9-13274)

(E73-10887; NASA-CR-133525) Avail: NTIS HC \$3.00 CSCL 14E

N73-30277* California Univ., Berkeley. Space Sciences Lab. **AN INTEGRATED STUDY OF EARTH RESOURCES IN THE STATE OF CALIFORNIA BASED ON ERTS-1 AND SUPPORTING AIRCRAFT DATA** Progress Report

Robert N. Colwell, Principal Investigator 31 May 1973 78 p Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21827)

(E73-10935; NASA-CR-133606; PR-4) Avail: NTIS HC \$6.00 CSCL 08F

N73-30304* North Carolina State Univ., Raleigh. Dept. of Geosciences.

UTILIZATION OF ERTS-A DATA IN GEOLOGICAL EVALUATION, REGIONAL PLANNING, FOREST MANAGEMENT, AND WATER MANAGEMENT IN NORTH CAROLINA Progress Report, Jul. - Aug. 1973

Charles W. Welby, Principal Investigator 31 Aug. 1973 33 p refs ERTS

(Contract NAS5-21732)

(E73-10962; NASA-CR-133648) Avail: NTIS HC \$3.75 CSCL 08F

N73-30308* North Carolina State Univ., Raleigh.

UTILIZATION OF EREP DATA IN GEOLOGICAL EVALUATION, REGIONAL PLANNING, FOREST MANAGEMENT, AND WATER MANAGEMENT IN NORTH CAROLINA Quarterly Progress Report

Charles W. Welby, Principal Investigator 10 Sep. 1973 1 p EREP

(Contract NAS9-13321)

(E73-10966; NASA-CR-133745) Avail: NTIS HC \$3.00 CSCL 08F

N73-30317# Joint Publications Research Service, Arlington, Va.

MEETING OF THE SOVIET-AMERICAN WORKING GROUP ON REMOTE SENSING OF THE NATURAL ENVIRONMENT FROM SPACE

8 Aug. 1973 193 p refs Transl. into ENGLISH of the publ. "Vstrecha Sovetsko-Amerikanskoy Rabochey Gruppy po Issledovaniyu Okruzhayushchey Sredy iz Kosmosa" Moscow, Acad. of Sci. USSR, 1973 173 p Conf. held at Moscow, 12-17 Feb. 1973

(JPRS-59739) Avail: NTIS HC \$11.75

Research papers are presented on the geological interpretation of images of the earth taken from outer space and their application for mapping the natural environment.

N73-30318 Joint Publications Research Service, Arlington, Va.
TECHNICAL MEDIA FOR OBTAINING, DELIVERING AND PROCESSING IMAGES TAKEN FROM SPACE

In its Meeting of the Sov.-Am. Working Group on Remote Sensing of the Nat. Environment from Space (JPRS-59739) 8 Aug. 1973 p 3-15 refs Transl. into ENGLISH from the publ. "Vstrecha Sovetsko-Amerikanskoy Rabochey Gruppy po Issledovaniyu Okruzhayushchey Sredy iz Kosmosa" Moscow, Acad. of Sci. USSR, 1973

An overview is presented of the development of technologies and equipment in the US and USSR for high resolution space photography of the earth. The earth satellites of both countries are discussed in terms of onboard equipment, photographic techniques, image transmission, and ground processing procedures. Particular emphasis is placed on the advanced technologies employed with the ERTS satellites. D.L.G.

N73-30321 Joint Publications Research Service, Arlington, Va.
SELECTION OF STANDARD SECTIONS AND ORGANIZATION OF OPERATIONS IN THEM

In its Meeting of the Sov.-Am. Working Group on Remote Sensing of the Nat. Environment from Space (JPRS-59739) 8 Aug. 1973 p 31-33 Transl. into ENGLISH from the publ. "Vstrecha Sovetsko-Amerikanskoy Rabochey Gruppy po Issledovaniyu Okruzhayushchey Sredy iz Kosmosa" Moscow, Acad. of Sci. USSR, 1973

Standard sections are defined as those which encompass the territories in which a procedure for geological interpretation of photographs from space must be developed. The factors involved in determining these sections are reviewed and the selection of three standard sections in the territory of the USSR is discussed. D.L.G.

N73-30330# Scientific Translation Service, Santa Barbara, Calif.

APPLICATIONS SATELLITES: LEGAL ASPECTS. PART 2: THE REMOTE SENSING OF EARTH RESOURCES BY SATELLITES

A. Tchernog Washington NASA Aug. 1973 18 p refs Transl. into ENGLISH from Rech. Spatial (France), v. 12, no. 3, 1973 p 1-5 (Contract NASw-2483)

(NASA-TT-F-15055) Avail: NTIS HC \$3.00 CSCL 08F

The development of laws, as well as their enforcement concerning remote sensing is discussed within the framework of a large international cooperative effort. The legal areas applicable to remote sensing, international law, specific regulations, data collection, data distribution, judicial regions, and ground and space sectors are also discussed. T.M.R.

N73-30353# European Space Research Organization, Paris (France). Space Applications Div.

AN EARTH RESOURCES AIRCRAFT FACILITY

J. Plevin 1973 27 p refs Presented at the Brit. Interplanet. Soc. Symp. on Earth Observation Satellites, London, Apr. 1973 Avail: NTIS HC \$3.50

An earth resources aircraft facility (ERAF) is described, fitted with a wide range of advanced remote sensing instruments, e.g. side-looking radar multispectral scanners and passive microwave

radiometers. The facility would provide the central component for the preparatory phase of a European earth resources satellite program. The ERAF missions are considered, and the sensors, sensor support systems, and avionics requirements are discussed. The basic aircraft specifications are given, and the Brequet 1150 Atlantic aircraft is described. The data processing facility for the program is also discussed. ESRO

N73-30370# Environmental Research Inst. of Michigan, Ann Arbor.

PROCEEDINGS OF THE 8TH INTERNATIONAL SYMPOSIUM ON REMOTE SENSING OF ENVIRONMENT, VOLUME 1 Final Report

Jerald J. Cook Oct. 1972 815 p refs Proc. held at Ann Arbor, Mich., 2-6 Oct. 1972 Sponsored by Michigan Univ., NASA, EPA, DOT, Dept. of Interior, Dept. of Agr., AFOSR, NONR, NOAA, TVA

(Grant AF-AFOSR-2372-72; AF Proj. 9751)

(NASA-CR-133784; AFOSR-73-0980TR-Vol-1; AD-761559; ERIM-195600-1-X-Vol-1) Avail: NTIS HC \$45.75 CSCL 08/6

These Proceedings contain papers presented at the Eighth International Symposium on Remote Sensing of Environment, held October 2nd through 6th, 1972, on the campus of the University of Michigan. The symposium was conducted by the Center for Remote Sensing Information and Analysis of the Environmental Research Institute of Michigan (formerly the University of Michigan's Willow Run Laboratories) as a part of a continuing program investigating current activities in the field of remote sensing. Presentations include those on the use of this technology by regional governmental units and by federal governmental agencies, as well as various applications in monitoring and managing the earth's resources and man's global environment. Ground-based, airborne, and spaceborne sensor systems and manual and machine-assisted data analysis and interpretation are included. Author (GRA)

N73-30383# Office of Water Resources Research, Washington, D.C. Water Resources Scientific Information Center.

AERIAL REMOTE SENSING, A BIBLIOGRAPHY

Donald B. Stafford, ed. (Clemson Univ.) Mar. 1973 488 p refs (PB-220163/0; WRSIC-73-211) Avail: NTIS HC \$10.60 CSCL 08F

The report, containing 272 abstracts, is another in a series of planned bibliographies in water resources to be produced from the information base comprising Selected Water Resources Abstracts (SWRA). At the time of search for this bibliography, the data base had 50,631 abstracts covering SWRA through December 15, 1972 (Volume 5, Number 24). Author and subject indexes are included. Author (GRA)

N73-30906# Committee on Aeronautical and Space Sciences (U. S. Senate).

NASA AUTHORIZATION FOR FISCAL YEAR 1974, PART 1

Washington GPO 1973 578 p refs Hearings on S. 880 before Comm. on Aeronautics and Space Sci., 93d Congr., 1st Sess., 28 Feb., 6-7 and 9 Mar. 1973 3 Vol.

Avail: SOD HC \$2.60 Domestic Postpaid or \$2.25 GPO Bookstore

Congressional hearings to authorize appropriations to NASA for research and development during Fiscal Year 1974 are presented. NASA activities for FY 1973 are discussed and funding implications for FY 1974 are derived. Charts, photographs, and drawings of NASA projects are included. Specific testimony is submitted on the Skylab program, the Space Shuttle program, and the Earth Resources Technology Satellite program. Author

N73-31302# National Research Council, Bangkok (Thailand). **THAILAND NATIONAL PROGRAMME OF THE EARTH RESOURCES TECHNOLOGY SATELLITE** Progress Report, May - Jul. 1973

09 GENERAL

Pradisth Cheosakul, Principal Investigator Aug. 1973 25 p
Sponsored by NASA Original contains color imagery Original
photography may be purchased from the EROS Data Center,
10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(E73-10996; NASA-CR-133777) Avail: NTIS HC \$3.25 CSCL
08F

N73-31306* Houston Univ., Tex. Wave Propagation Labs.
[SKYLAB OVERPASS AND VERIFICATION OF LOCAL
ENVIRONMENTAL AND SPATIAL FEATURES] Quarterly
Report, May - Aug. 1973
H. S. Hayre, Principal Investigator 11 Sep. 1973 1 p EREP
(Contract NAS9-13462)
(E73-11001; NASA-CR-133782) Avail: NTIS HC \$3.00 CSCL
08F

N73-31331* Bureau of Reclamation, Denver, Colo.
APPLICATION OF REMOTE SENSING TO SELECTED
BUREAU OF RECLAMATION PROJECTS Progress Report,
1 Jul. - 31 Aug. 1973
Larry D. Cast, Principal Investigator 1 Sep. 1973 2 p ERTS
(NASA Order S-70243-AG)
(E73-11027; NASA-CR-133824) Avail: NTIS HC \$3.00 CSCL
08B

N73-31372* European Space Research Organization, Paris
(France).
DIRECTORY OF EUROPEAN ACTIVITIES IN THE REMOTE
SENSING OF EARTH RESOURCES
May 1973 207 p
(ESRO/JPPC-73-20-add-1) Avail: NTIS HC \$12.50
European earth resources survey programs using remote
sensing methods are listed. Also included is a summary providing
a comparative assessment of remote sensing activities since the
first edition published in November 1971. ESRO

N73-31867* National Aeronautics and Space Administration.
Goddard Space Flight Center, Greenbelt, Md.
SIGNIFICANT ACCOMPLISHMENTS IN SCIENCES:
GODDARD SPACE FLIGHT CENTER, 1972
Washington 1973 223 p Proc. of a Symp., Greenbelt, Md.,
7-8 Nov. 1972
(NASA-SP-331) Avail: NTIS HC \$5.50 CSCL 05B
Space applications research is reported in the following areas:
High energy and solar astronomy; optical and UV astronomy;
Planetary, lunar, and cometary studies; earth observations; and
earth physics.

N73-31900* National Aeronautics and Space Administration.
Goddard Space Flight Center, Greenbelt, Md.
EARTH OBSERVATIONS, OVERVIEW
William Nordberg In its Significant Accomplishments in Sci.
1973 p 161-177
CSCL 08E

N73-31909* National Aeronautics and Space Administration.
Goddard Space Flight Center, Greenbelt, Md.
EARTH PHYSICS, OVERVIEW
Friedrich O. VonBun In its Significant Accomplishments in Sci.
1973 p 211
CSCL 08E

N73-32264* Environmental Research Inst. of Michigan, Ann
Arbor. Infrared and Optics Div.
[MULTIDISCIPLINARY INVESTIGATIONS UTILIZING
ERTS-1 DATA] Bimonthly Report, 1 Jul. - 31 Aug. 1973
Frederick J. Thomson, F. C. Polcyn, M. Leonard Bryan, I. J.
Sattinger, W. A. Malila, R. F. Nalepka, C. T. Wozniak, R. Horvath,
and R. K. Vincent, Principal Investigators 19 Sep. 1973 101 p
refs Original contains imagery. Original photography may be
purchased from the EROS Data Center, 10th and Dakota Avenue,
Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21783)
(E73-11119; NASA-CR-135622; ERIM-193300-24-L; BMR-6)
Avail: NTIS HC \$7.25 CSCL 05B

N73-32740* Kanner (Leo) Associates, Redwood City, Calif.
STUDY OF TERRESTRIAL RESOURCES BY SPACE
OBJECTS AND INTERNATIONAL LAW
Marco G. Marcoff Washington NASA Oct. 1973 11 p refs
Transl. into ENGLISH from Rev. Gen. de l'Air et de l'Espace
(France), v. 35, no. 4, 1972 p 343-348
(Contract NASW-2481)
(NASA-TT-F-15094) Avail: NTIS HC @3.00 CSCL 03B

The teleobservation and surveillance of the surface of the
earth by satellite cannot limit itself solely to the geographical
confines of the state or states which have authorized the activity,
or who are participating in the experiments. In regard to risks
of international disputes arising from space prospecting of
terrestrial resources, even if carried out with the consent of
certain states, and taking account of the contradictory interests
of the economic and military establishments implied in this type
of activity, it is to be hoped that the judicial subcommittee of
the U.N. will not delay in initiating appropriate international
procedures. Author

N73-33250* Alaska Univ., Fairbanks. Geophysical Inst.
COORDINATION AND ESTABLISHMENT OF CENTRALIZED
FACILITIES AND SERVICES FOR THE UNIVERSITY OF
ALASKA ERTS SURVEY OF THE ALASKAN ENVIRONMENT
Bimonthly Progress Report
Albert E. Belon, Principal Investigator 30 Sep. 1973 11 p
refs ERTS
(Contract NAS5-21833)
(E73-11088; NASA-CR-135556; BMPP-7) Avail: NTIS HC
\$3.00 CSCL 14B

N73-33283* Alaska Univ., Fairbanks.
ERTS-A DATA AS A TEACHING AND RESEARCH TOOL
IN THE DEPARTMENT OF GEOLOGY Bimonthly Progress
Report
Donald Grybeck, Principal Investigator 4 Oct. 1973 2 p
ERTS
(Contract NAS5-21833)
(E73-11128; NASA-CR-135666; BMPP-6) Avail: NTIS HC
\$3.00 CSCL 08G

N73-33292* Alabama Univ., University. Bureau of Engineering
Research.
INVESTIGATIONS USING DATA IN ALABAMA FROM
ERTS-A Bimonthly Progress Report, 7 Aug. - 6 Oct. 1973
Harold R. Henry, George P. Whittle, Principal Investigators, and
James A. Drahovzal, comp. (Geol. Survey of Ala.) 7 Oct. 1973
151 p refs Original contains imagery. Original photography
may be purchased from the EROS Data Center, 10th and Dakota
Avenue, Sioux Falls, S. D. 57198 ERTS
(Contract NAS5-21876)
(E73-11137; NASA-CR-135684) Avail: NTIS HC \$9.75 CSCL
05B

N73-33312* Arizona Univ., Tucson. Dept. of Watershed
Management.
USE OF EARTH RESOURCES TECHNOLOGICAL SATELLITE
(ERTS) DATA IN A NATURAL RESOURCE INVENTORY
Progress Report, 1 Apr. - 30 Sep. 1973
Phil R. Ogden, Principal Investigator 22 Oct. 1973 3 p
ERTS
(Contract NAS5-21820)
(E73-11159; NASA-CR-135748) Avail: NTIS HC \$3.00 CSCL
08M

N73-33330* Eastman Kodak Co., Rochester, N.Y. Kodak
Apparatus Div.
TECHNICAL CONSULTING SERVICES FOR EARTH RE-
SOURCE PROGRAM Monthly Status Report
30 Sep. 1973 9 p

(Contract NASw-2317)

(NASA-CR-135793) Avail: NTIS HC \$3.00 CSCL 05A

Evaluations of several sets of test data which show a normal amount of variability in gamma and Dmax on KODAK Aerial Duplicating Film (ESTAR Base) SO-467 are reported. Kodak is now furnishing to engineers at GSFC a full set of test data for each coating of SO-467 film. Glass-enclosed sensitometer step tablets which are being made for the Herrnfeld instrument at GSFC are discussed. These tablets include a gray scale and uniformity check areas as well as tribar resolution patterns imaged in a durable chromium layer. It is recommended that the Sioux Falls EDC procure four new enlarging printers and study the value and economics of a system for printer automation based on edge coding.

Author

N73-33812*# National Aeronautics and Space Administration, Washington, D.C.

SKYLAB EXPERIMENTS. VOLUME 2: REMOTE SENSING OF EARTH RESOURCES

May 1973 89 p refs Prepared in cooperation with Colo. Univ.

(NASA-EP-111) Avail: NTIS MF \$1.45; SOD HC \$1.25 CSCL 22C

This volume covers the broad area of earth resources in which Skylab experiments will be performed. A brief description of the Skylab program, its objectives, and vehicles is included. Section 1 introduces the concept and historical significance of remote sensing, and discusses the major scientific considerations involved in remotely sensing the earth's resources. Sections 2 through 6 provide a description of the individual earth resource sensors and experiments to be performed. Each description includes a discussion of the experiment background and scientific objectives, the equipment involved, and a discussion of significant experiment performance areas.

Author

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